

# ***AIIPile***

*Version 6 and Later*

## ***User's Manual Volume 1***



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**CivilTech Software**

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# ***CHAPTER 1***

---

## ***INTRODUCTION***

This chapter provides information about:

- Our company background as an engineering consultant and software developer
- The program capabilities
- The manual and what it contains



## **1.1 About AllPile**

The program *AllPile for Windows Version 6* analyzes pile load capacity efficiently and accurately. AllPile can handle all types of piles: drilled shaft, driven pile, auger-cast pile, steel pipe pile, H-pile, timber pile, tapered pile, bell pile, shallow foundation, etc. You can define new pile types and input customized parameters based on local practices and experience. The program is capable of performing the following calculations:

- Lateral capacity and deflection
- Vertical capacity and settlement
- Group vertical and lateral analysis
- FHWA SHAFT program
- Static and cyclic conditions
- Negative and zero friction
- Shallow footing
- Tower foundation

The lateral calculation directly uses FHWA's COM624P. It is comparable with Ensoft's Lpile®.<sup>1</sup> In our tests, AllPile provided the same results as COM624P<sup>2</sup> and Lpile. AllPile is compatible with all Windows operating systems, such as 98/NT/2000/ME/XP.

## **1.2 About the Manual**

This manual has two volumes.

### *Volume 1:*

1. Describes how to install, activate, and start the program (Chapters 2 and 3).
2. Describes each input and output parameters (Chapter 4 and 5).
3. Describes customization of the program and how to set up calculation methods and parameters (Chapter 6).
4. Provides typical examples for using the software (Chapter 7).

### *Volume 2:*

5. Introduces the theory and methods of calculation used in the program (the user should be somewhat familiar with pile design theory) (Chapter 8).

## **1.3 About the Company**

CivilTech Software is a subsidiary of CivilTech Corporation, USA. CivilTech Software employs engineers with experience in structural, geotechnical, and software engineering. CivilTech has developed a series of engineering programs that are efficient, easy to use, engineering-oriented, practical, and accurate. The CivilTech Software program series includes Shoring Suite Plus, LiquefyPro, AllPile, SuperLog, and lab testing programs. These programs are widely used in the U.S. and around the world. For more information, please visit our web site at [www.civiltech.com](http://www.civiltech.com).

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<sup>1</sup> Lpile is a registered trademark of Ensoft, Inc.

<sup>2</sup> COM624P is a public-domain software downloadable free from the U.S. Federal Highways Administration web site.

# ***CHAPTER 2***

---

## ***INSTALLATION AND ACTIVATION***

This chapter provides information about:

- The installation procedures of the program
- How to properly active and register the program



## 2.1 Installation

The program has two activation methods: USB key activation and code activation. Prior to activation, the program is in demo mode. In demo mode, some functions of the program is disabled. Please follow the installation and activation procedures below that correspond to your version of the software.

### Setup (USB Key)

#### From CD:

1. Insert the CivilTech CD into the CD-ROM drive.

**Note:** For Windows 3.1, go to **FILE** menu and select **RUN**. Type in “D:setup”. For Windows 98/NT/2000/ME/XP, if the installation does not start automatically, click on **START** and select **RUN**. Type in “D:setup”.

2. When the setup screen appears, click on **AllPile** under INSTALLATION. Follow the instructions on the screen. The installation program will automatically copy the program files into a new directory called “AllPile6”, and create an icon called **AllPile6** on your Windows desktop.

**ATTENTION: Do NOT put the USB key into the USB port until asked to do so.**

3. Once setup is completed, click **Finish** and AllPiles V6 will launch.
4. The activation key screen will appear. There will be instruction on the panel and ask you to close the program. Click **Close Program**.
5. After the program has closed, plug the USB key into any unused USB port. If you already plug the key in, you need to unplug the key and plug it in again.
6. Windows will detect the new hardware (USB key)



**Note:** If your computer does not detect the USB key, you will have to manually install the driver from the installation disk.

**Step 1.** Explore the CD using **My Computer**.

**Step 2.** Double click on the InstDrv.exe icon.

7. After installation of the USB key driver is complete, run **AllPile**. The program will check for the key. If the message “Find Activation Key!” is displayed on the side panel. The program is ready for use.

**Hint:** It is possible, particularly for Win98 users, that the USB

support option inside the BIOS has been disabled. You can enable USB support in the CMOS functions menu when your computer is booting up. Please contact our staff if you need assistance for this procedure.

8. The key activation status can be checked from Help manual under Activation Key.

**Note:** For WinXP users, an USB key warning message may appear when you are installing your driver. Please ignore the message and complete the installation.

### Download Program from Internet:

1. The most recent copy of the software can be downloaded from our Web site ([www.civiltech.com/software/download.html](http://www.civiltech.com/software/download.html)).
2. Select the most recent version of **AllPile** for download. The program is in demo version if the activation key is not detected. All functions on the Demo version will be unlock when the activation key is plugged in. The browser will prompt you to save the file to a directory.
3. After download, find the downloaded file **al\_setup.exe** and open it. The program will start up the installation process automatically. Follow the above installation procedures for CD to complete the installation.

### Download Manual from Internet:

The most updated manual for AllPile can be downloaded from our Web site ([www.civiltech.com/software/download.html](http://www.civiltech.com/software/download.html)). Click on **AllPile Manual** link to open the manual, (you must have Adobe Acrobat Reader to open the file). Then, save the PDF file onto your hard drive.

### Setup (Code)

#### From CD:

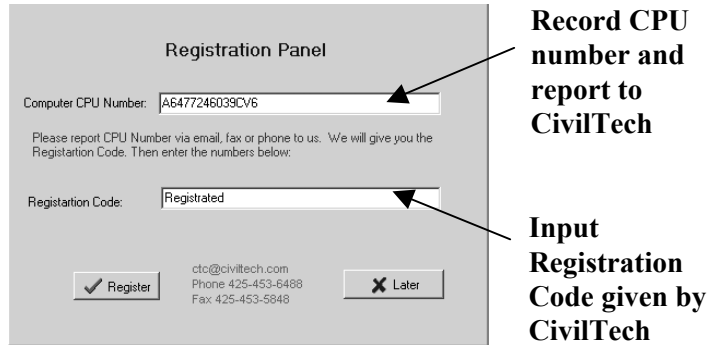
1. Follow steps 1 to 3 above.
2. After installation is complete, the program will launch. The first time you run the program, the registration panel will show up automatically. You also can open it from the **Help** menu under **[Register]**.



3. The registration panel will appear. The CPU number is shown at the top in Red block letters. This is a unique number for your computer, which must be reported to CivilTech for the Registration Code. Please download the registration form from <http://www.civiltech.com/software/registration.doc>, fill out all the

## Chapter 2: Installation and Activation

required fields and fax it back to us at (425) 453-5848; or by email at [ctc@civiltech.com](mailto:ctc@civiltech.com).



The screenshot shows a 'Registration Panel' window. It contains two input fields: 'Computer CPU Number' with the value 'A6477246039CV6' and 'Registration Code' with the value 'Registered'. Below these fields is a 'Register' button with a checkmark icon and a 'Later' button with an 'X' icon. Text at the bottom provides contact information: 'ctc@civiltech.com', 'Phone 425-453-6488', and 'Fax 425-453-5848'. Two arrows point from text annotations to the input fields: one from 'Record CPU number and report to CivilTech' to the CPU Number field, and another from 'Input Registration Code given by CivilTech' to the Registration Code field.

**Registration Panel**

Computer CPU Number: A6477246039CV6

Please report CPU Number via email, fax or phone to us. We will give you the Registration Code. Then enter the numbers below.

Registration Code: Registered

Register Later

ctc@civiltech.com  
Phone 425-453-6488  
Fax 425-453-5848

**Record CPU number and report to CivilTech**

**Input Registration Code given by CivilTech**

4. Your Registration Code will be given to you, after you submit your request form.
5. After inputting the Registration Code in the Registration Panel, Click on **Register**.
6. The program will respond with a message box confirming your registration.

### Starting the Program

Open ALLPILE using the shortcut icon on your Windows desktop. After initial installation, the program will be in demo mode. User must activate the program with a registration code or with the USB key in order to unlock full functions of the software program.

### Quitting the Program

From the **F**ile menu, select [**E**xit] or Ctrl+X.

### Input Firm and User Name

From the **H**elp menu, select **Firm and User**. Once the panel pulls out, enter in your firm's name and the user name. These information will be printed in the report.

### About Program

From the **H**elp menu, select **About**. This will provide you with the version of the program. Click anywhere on the screen to exit back to the program.

**Note:** The program is not compatible for networking. You cannot install the program on your network server and run it from workstations. The program is one copy per license, which can only be installed in one workstation.

# ***CHAPTER 3***

---

## ***INTRODUCING ALLPILE***

This chapter will:

- Give an overview of the program
- Identify the basic functions of the program.

### 3.1 Program Overview

AllPile operations can be divided into three main steps (Figure 3-1).

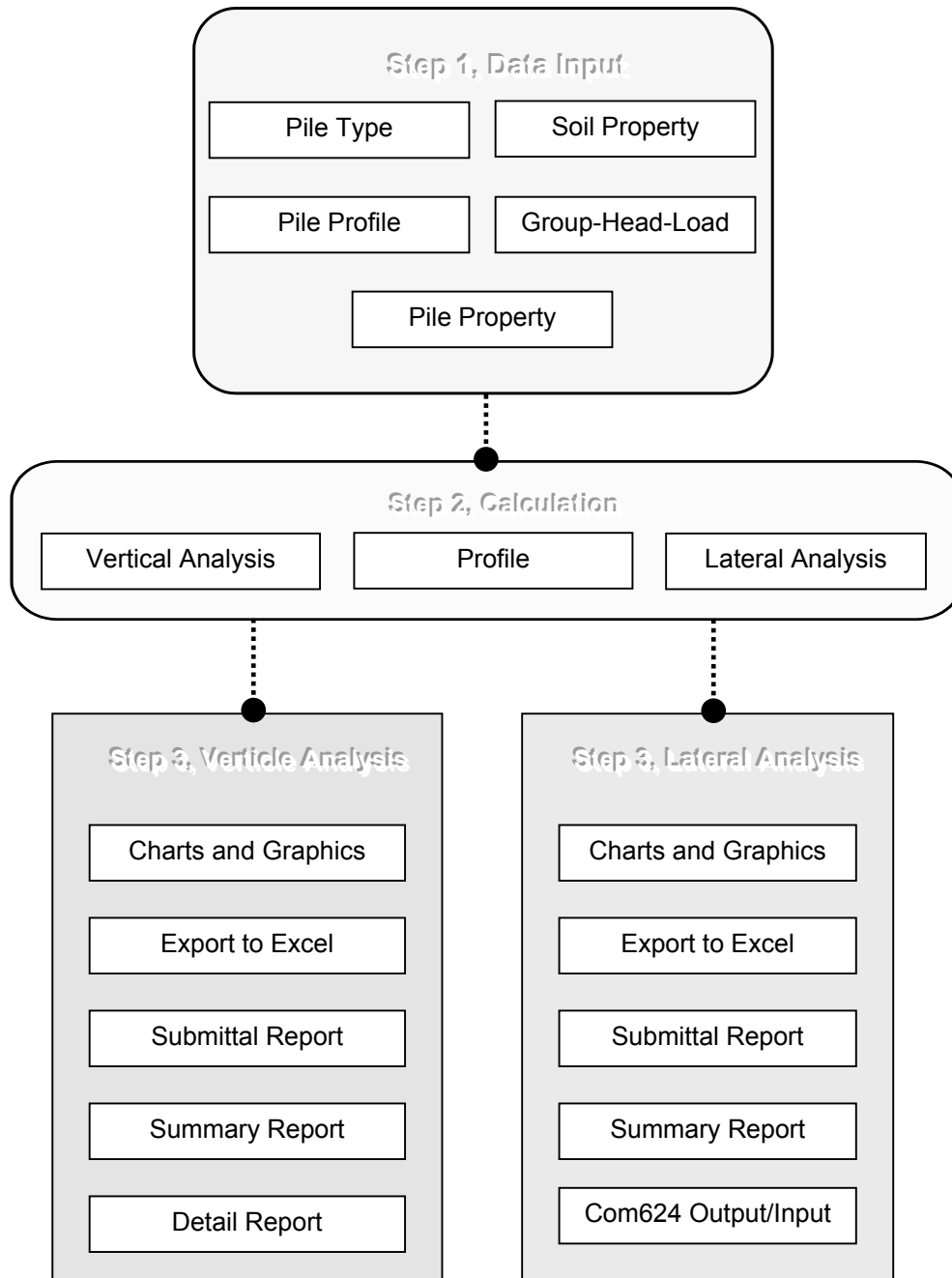


Figure 3-1. Program Flow

- Step 1.**            **Input Data:** Enter information into the tabbed input pages (Figure 3-2). This step is described in detail in Chapter 4.
- Step 2.**            **Execute Calculation:** Press either the **[Vertical Analysis]** button or the **[Lateral]** button after inputting all the required data. The **[Profile]** button provides the profile of the pile and soil information.
- Step 3.**            **View and Print Results (Reports):** After **Step 2.**, select the reports and charts you want from the result panel. See Chapter 5 for details.

## 3.2 Program Interface

AllPile's program interface has three main components (Figure 3-2):

1. (Top) **Pull-down menus** of standard Windows type commands
2. (Second row) **Speed bar** with shortcut command buttons and samples.
3. **Input pages**, six tabs to open the desired data input page

The first two rows are described below. The input pages are described in detail in Chapter 4.

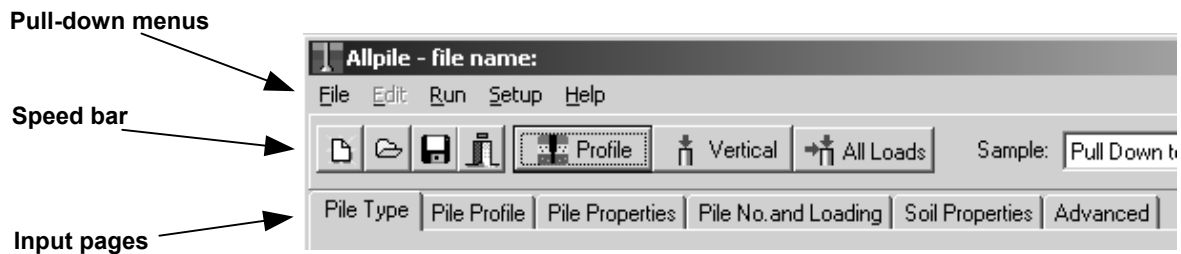


**Figure 3-2.** Main Components of Program Interface

### 3.3 Pull-Down Menus

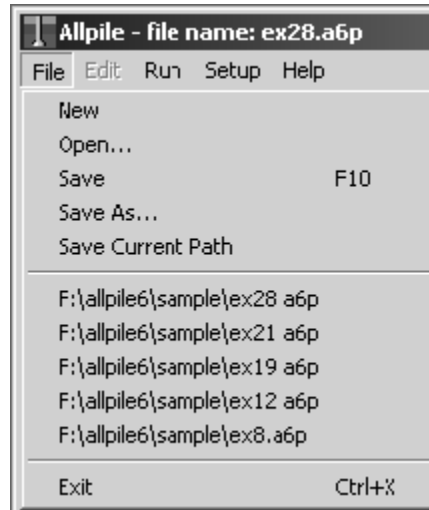


Figure 3-3. File Pull-Down Menu

**HINT:** You can use the Alt key plus the underlined letter to open the pull-down menu. For example, press Alt+F to pull down the File submenu.

After the pull-down menu is open, you can type the underlined letter to select an option. For example, in the File submenu, press N to select New.

#### 3.3.1 File

|                             |                                                                                                                                                                                                                                                  |
|-----------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b><u>N</u>ew</b>           | Create a new data file.                                                                                                                                                                                                                          |
| <b><u>O</u>pen</b>          | Open an existing file. A dialog box with a list of files will open on the screen. Select the file you want and open or click on Cancel to return to program.                                                                                     |
| <b><u>S</u>ave (F10)</b>    | Save the file you are working on (save your open files periodically to avoid losing data in case of a system crash). If the file is untitled, the program will automatically switch to the “Save as” command and ask you to provide a file name. |
| <b>Save <u>A</u>s</b>       | Save a new untitled file or change the file name or location of the file you are working with.                                                                                                                                                   |
| <b>Save Current Path</b>    | Select this option to make the program “remember” the current path. When you open the program next time, it will automatically go to this path to find your data files.                                                                          |
| <b>Historical file list</b> | Lists the five most recent files you used. You can click on any one of them to open the file instantly.                                                                                                                                          |
| <b><u>E</u>xit</b>          | Exit the program. You will be prompted to save any open files.                                                                                                                                                                                   |

### 3.3.2 Edit

The edit menu will be functional when the Pile Properties Table is active (Figure 4-4) or Soil Property Table is active (Figure 4-9).

|                             |                                                                    |
|-----------------------------|--------------------------------------------------------------------|
| <b>Insert row</b>           | Insert a blank row in the table                                    |
| <b>Insert duplicate row</b> | Insert a row with the same data as the row selected                |
| <b>Clear row</b>            | Clear (delete) the data in the selected row and create a blank row |
| <b>Delete row</b>           | Delete the selected row from the table and shift next row up       |

**HINT:** Select a row by clicking any cell in the row. The selected cell will be highlighted in blue.

### 3.3.3 Run

The **Run** menu gives options for executing the program's analyses. If you have not entered enough data to run the program, it will not execute.

|                       |                                   |
|-----------------------|-----------------------------------|
| <b>Profile (F4)</b>   | Generate profile with information |
| <b>Vertical (F5)</b>  | Run vertical analysis only        |
| <b>All Loads (F6)</b> | Run vertical and lateral analyses |

### 3.3.4 Setup

The **Setup** menu allows you to enter the material properties for the piles and the properties of different pile types.

|                              |                                                                            |
|------------------------------|----------------------------------------------------------------------------|
| <b>Open Setup</b>            | Open the Setup Options screen to set parameters related to pile properties |
| <b>Close Setup</b>           | Close Setup Screen and return to program interface without saving changes  |
| <b>Save Setup</b>            | Save your changes in settings                                              |
| <b>Restore Saved Setup</b>   | Clear the screen and reload the previous saved setting                     |
| <b>Restore Default Setup</b> | Clear the screen and reload the default settings                           |
| <b>Print Setup</b>           | Open Notepad to view and print the setup data                              |

### 3.3.5 Help

|                                         |                                                                                                                    |
|-----------------------------------------|--------------------------------------------------------------------------------------------------------------------|
| <b>Help/Manual (F1)</b>                 | Open the help manual                                                                                               |
| <b>Activation Key/Registration Code</b> | Check status of activation key or get information about registration code (register program if not yet registered) |
| <b>Firm and User</b>                    | Input firm and user name                                                                                           |
| <b>About</b>                            | Display information about the version of your program and CivilTech's contact information                          |

### 3.4 Speed Bar

The speed bar provides seven short-cut buttons for certain commands and a quick pull down manual containing examples of pile designs. Figure 3-4 shows the buttons and their corresponding commands.

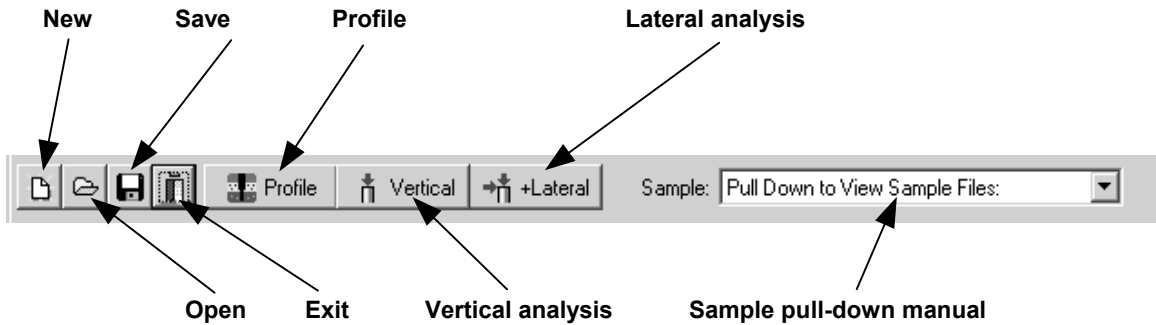


Figure 3-4. Speed Bar

### 3.5 Sample and Templates

The pull-down manual has thirty examples to illustrate how to use the program. These examples can also be used as templates, in which the user can modify these examples and save it as a different file name. The original examples cannot be overwritten.

# ***CHAPTER 4***

---

## ***DATA INPUT***

This chapter will examine:

- The input fields of the program
- How each variable can be modified to fit the analysis

## 4.1 Input Pages

The input pages of AllPile are categorized into six tabbed pages (see Figure 4-1). These pages and their relative input parameters are listed below:

|                                  |                                                           |
|----------------------------------|-----------------------------------------------------------|
| <b>Pile Type page</b>            | Input pile type and general information about the project |
| <b>Pile Profile page</b>         | Input pile orientation and positioning                    |
| <b>Pile Properties page</b>      | Input pile section data                                   |
| <b>Pile No. and Loading page</b> | Input pile head, load, and pile group conditions          |
| <b>Soil Properties page</b>      | Input subsurface conditions                               |
| <b>Advanced page</b>             | Input analysis criteria                                   |



**HINT:** The units of measure used in this program are presented in Table 4-1 at the end of this chapter.

Figure 4-1. Pile Type Input Page

## 4.2 Pile Type Page

As shown in Figure 4-1, you can select the pile type that best suits your condition and design criteria. There are twelve different pile types to choose from the pile type list.

1. Drilled pile diameter less than or equal to 24 inches, such as auger cast
2. Drilled pile diameter is more than 24 inches, such as drilled shaft or pier
3. Shaft using US FHWA SHAFT methods of analysis
4. Driving steel pile with opened end, such as H-pile or open-end pipe
5. Driving steel pipe with closed end, including pipe with shoe on the tip
6. Driving concrete pile, such as pre-cased circular or square concrete pile
7. Driving timber pile, tapered pile with small tip and large top
8. Driving jetted pile, soils are jetted during driving
9. Micropile, is a pressure-grouted small-diameter pile, also called mini-pile.
10. Uplift anchor, frictionless steel bar with grouted ends (uplift only)
11. Uplift plate, frictionless steel bar with concrete or steel plates at the end (uplift only)
12. Shallow footing, spread footing for shallow foundations



**NOTE:** The parameters of each pile type can be customized in the Setup screen (Chapter 6).

### 4.2.1 Project Titles

The project title and subtitle can be input in these two boxes. The text will appear in the report. The location and font can be customized in the Setup screen described in Chapter 6.

### 4.2.2 Comments

The Comments box is for additional comments or descriptions of the project. You can choose to include this message in the profile section of the report by checking the **Show Memo in Profile Box**.

### 4.2.3 Units

Select between English or Metric units to be used throughout the program. If you change the units after input of data, the data you have entered will automatically convert to the units specified.

*Note:* However, the data will not be exactly the same after some truncation during conversion.

## 4.3 Pile Profile Page

This page presents pile profile information as shown in Figure 4-2. The diagram on the left side reflects the information you input on the right side.

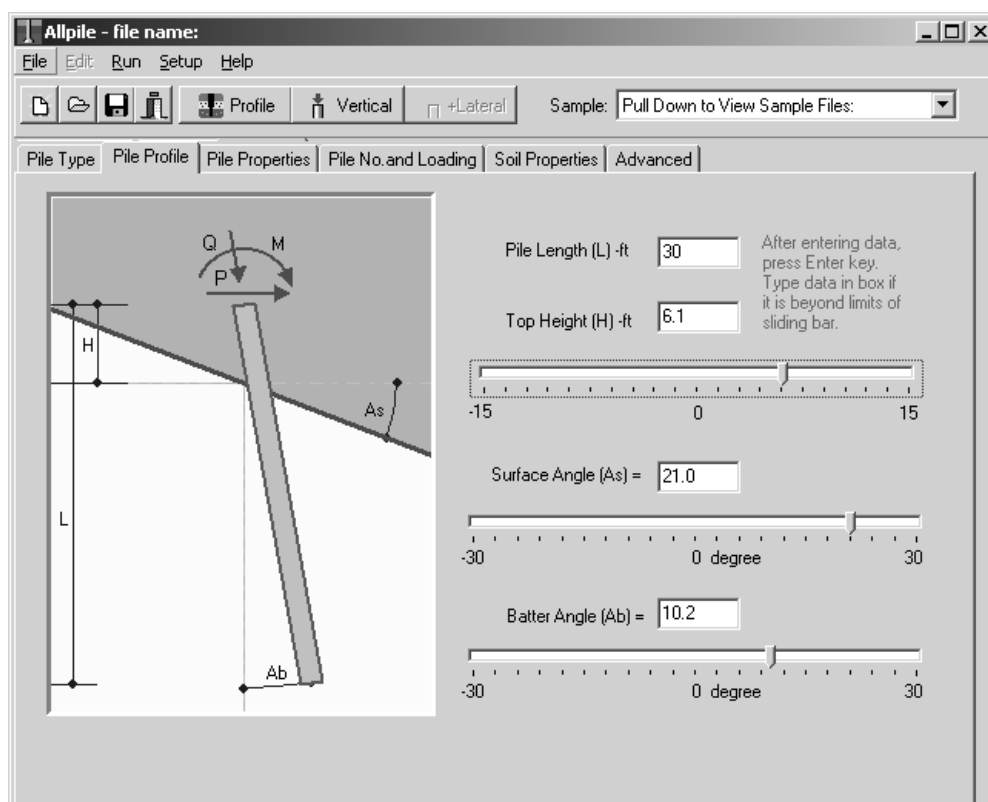


**Figure 4-2.** Pile Profile Input Page ( $H > 0$ )



**HINT:** You can enter pile data using either the interactive sliding bar or typing the numbers into the text boxes followed by [Enter]. Changes will be reflected in the profile on the left immediately. If the data exceed the limits of sliding, you can type data directly in the text box.

|                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|---------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Pile Length (L)</b>    | The total length of the pile, including above and below ground.                                                                                                                                                                                                                                                                                                                                                                                                                           |
| <b>Top Height (H)</b>     | <p>The distance from the top of the pile to the ground surface. <u>A negative value</u> indicates the pile is buried below the ground surface (see Figure 4-3). The sliding bar can also be used to select the desirable elevation.</p> <p>H is the distance from top of pile to ground surface:</p> <p><math>H &gt; 0</math> Pile top above ground (Figure 4-2)</p> <p><math>H = 0</math> Pile top at ground surface</p> <p><math>H &lt; 0</math> Pile top under ground (Figure 4-3)</p> |
| <b>Surface Angle (As)</b> | <p>If the ground surface is sloped, input the slope (in degrees) here.</p> <p><b>NOTE: Due to the limitations of the original COM624, the friction angle of any soils should be larger than the slope angle input here. Cohesive soil with zero or small friction angle in any layers cannot be associated with sloped ground surface.</b></p>                                                                                                                                            |
| <b>Batter Angle (Ab)</b>  | <p>If the pile is battered, input the batter angle here. The friction angle of any soils should be larger than the batter angle.</p>                                                                                                                                                                                                                                                                                                                                                      |

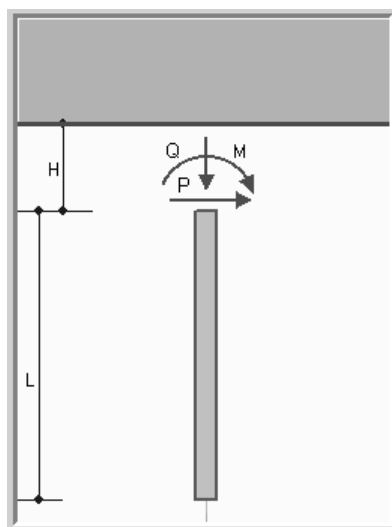


Figure 4-3. Pile Profile with  $H < 0$

## 4.4 Pile Properties Page

The table on the Pile Properties Page (Figure 4-4) allows you to choose the pile property. Ten different sections can be defined along the length of the pile. If the pile has a uniform section, you only need to input the first row. You should input all the data through the **Pile Section** screen shown in Figure 4-5 by clicking on the buttons of the **Pile Property Table** Figure 4-4.

| From Top -ft | Pile Data Input    | Width-in | Area-in2 | Per.-in | I-in4     | E -kp/ft | W -kp/ft |
|--------------|--------------------|----------|----------|---------|-----------|----------|----------|
| 0            | ● Concrete (rough) | 48       | 2593.7   | 150.8   | 266222.1  | 3000     | 2.10     |
| 37           | ● Concrete (rough) | 48       | 2280.0   | 150.8   | 210087.0  | 3000     | 2.01     |
| 40           | ● Pile Tip         | 120      | 5130.1   | 226.2   | 1063565.5 | 3000     | 4.53     |
|              | Click to Open      |          |          |         |           |          |          |
|              | Click to Open      |          |          |         |           |          |          |
|              | Click to Open      |          |          |         |           |          |          |
|              | Click to Open      |          |          |         |           |          |          |
|              | Click to Open      |          |          |         |           |          |          |
|              | Click to Open      |          |          |         |           |          |          |
|              | Click to Open      |          |          |         |           |          |          |

Click button to open Pile Section screen.

Add Tip Section

Only if bearing area is different from that of the last section, add a new section then modify the area equal to the bearing area.

**Figure 4-4.** Pile Properties Page and Pile Property Table

|                        |                                                                                                                                                                                                              |
|------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>From Top</b>        | Input the distance from the top of the pile to the start of the following section having different pile properties (NOT from the ground surface). The first row is always zero.                              |
| <b>Pile Data Input</b> | Press the button in this column to select details from the Pile Section screen (Figure 4-5). You should input all the pile property data on the Pile Section screen instead of on the Pile Properties table. |
| <b>Width</b>           | Width of the pile section, or the pile diameter for a circular pile.                                                                                                                                         |
| <b>Area*</b>           | Effective area of the pile section or total area of tip.                                                                                                                                                     |
| <b>Perimeter</b>       | Perimeter of the pile section.                                                                                                                                                                               |
| <b>Inertia*</b>        | Effective moment of inertia of the pile.                                                                                                                                                                     |
| <b>E</b>               | Elastic modules of outside materials.                                                                                                                                                                        |
| <b>W</b>               | Weight of the pile section for uplift calculation. It is per foot or meter.                                                                                                                                  |

\* - See the **Effective Area** and **Total Area** section in this chapter.

### 4.4.1 Add Tip Section

This button will add an optional tip section at the bottom of pile. The area is based on the outside perimeter of the pile. Users can modify the data, which is only for tip resistance calculation. If tip section is not added, then program assumes the tip section is the same as the last section, which uses effective area.

The tip section screen is different from the overall section screen as shown in Figure 4-5. A tip section uses total area,  $A$ , instead of the effective Area,  $A'$ . For more details, refer to “Effective Area and Total Area” section of this chapter. For tip section input, user can choice to input their own ultimate bearing pressure (capacity) or let the program generate its' own. If the user defines their own ultimate capacity, the program will directly use the value for analysis without modification in the calculation.

### 4.4.2 Pile Section Screen

The Pile Section screen is for inputting pile material and size for the particular section of the pile. Some of the fields in this window are the same as the fields shown on the Pile Property table, you can input or change these properties in either place.

Described below are seven general steps for inputting section properties. When you are done, press [Apply] button to save the data. If you press [Cancel], the data will not be saved and the Pile Property table (Figure 4-4) will not be changed. If you have selected Shallow foundation as the pile type, you will get the shallow foundation window for parameters input instead of the one below. Refer to Section 4.4.4.

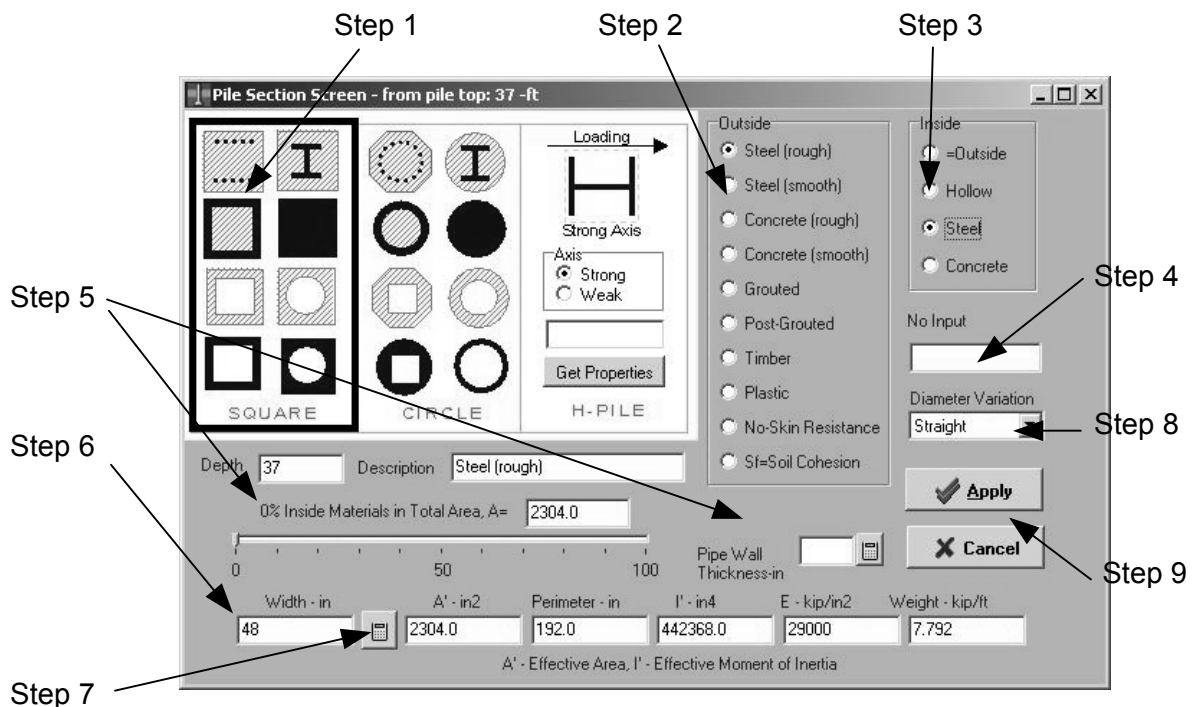


Figure 4-5. Pile Section Screen

**Step 1. Select Pile Shape**

The shape of the pile can be square/rectangular, circular/octangular, or H-shaped. The internal configuration of the pile can be solid (one material), hollow (square or circular space inside), or different material on the skin than on the inside.

If you select H-pile, you can also input the pile designation, such as W24X94. Then select strong or weak axis (used for lateral analysis). Strong axis means the lateral load is acting in the same direction as the pile axis (X-X). Next, press [**Get Properties**] and the program will search the database and get the corresponding properties for the H-pile. If no match is found, the program will select the closest size pile or give a warning message.

**Step 2. Select Outside Skin Materials**

Select the outside skin material from the materials list. Skin material affects the result for vertical analysis. The parameter of each material can be modify in setup screen.

|                                         |                                                                                                                                                  |
|-----------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Steel-Rough</b>                      | Specially treated rough surface                                                                                                                  |
| <b>Steel-Smooth</b>                     | Steel pipe or H-pile with normal surface                                                                                                         |
| <b>Concrete-Rough</b>                   | Concrete cast directly against the soil such as auger-cast piles                                                                                 |
| <b>Concrete-Smooth</b>                  | Concrete cast in steel casing with smooth surface or pre-cast concrete pile                                                                      |
| <b>Grouted</b>                          | Cement with high grouting pressure during installation such as tie-back anchor or micropile                                                      |
| <b>Post-Grouted</b>                     | Grouting twice or more with higher grouting pressure                                                                                             |
| <b>Timber (Tapered)</b>                 | Timber pile with large top and smaller tip (users should define the start depth and the start diameter, then the end depth and the end diameter) |
| <b>Plastic</b>                          | Pile with plastic surface                                                                                                                        |
| <b>No-friction Steel</b>                | No friction, or frictionless part of pile, such as the unbound length of tieback anchor                                                          |
| <b><math>S_f</math> = Soil Cohesion</b> | The ultimate side resistance equal to soil cohesion. There is no other modifications involved                                                    |

**Step 3. Select Inside Materials**

The inside of the pile can be:

|                  |                                       |
|------------------|---------------------------------------|
| <b>= Outside</b> | The same material as the outside skin |
| <b>Hollow</b>    | No material inside                    |
| <b>Steel</b>     | Reinforcement bar in concrete         |
| <b>Concrete</b>  | Steel pipe filled with concrete       |
| <b>Plastic</b>   | Pile with plastic core                |

Note: *refer to Step 5 below to identify the percentage of inside materials to outside material*

**Step 4. Reduction Factors or Adhesion**

If material of the pile is concrete, users can input reduction factor to reduce the moment of inertia due to cracking of the concrete (**30%** is typically used).

If metal is grouted or post-grouted section (Anchor or micro-pile), then adhesion can be inputted.

**Step 5. Percentage of Inside Materials of Total Area, and Total Area**

If inside materials are different from outside materials, use the sliding bar to select the percentage of different material on the inside as a proportion of the total area of the section. 100% means the inside materials make up the entire pile section. The Pipe Wall Thickness can also be used to determine the composition of inside material and outside material (the sliding bar will change accordingly). After inputting the wall thickness, press . Users can directly input total area in the box.

If the outside material is concrete or grout, the program will allow you to input the **Bar Size** and **Bar Number**.

**Bar Size** Based on ASTM standard reinforcement bars

**Bar Number** Number of bars in the pile

**Step 6. Width of Pile**

Input width of pile section as follows:

**Square section** input side width

**Circular section** input diameter

**Rectangular section** input square root of (long side x short side)

**Octangular section** input average diameter

**H-pile** press [Get Properties] button to get data.

**Step 7. Effective Area, Perimeter, I, E, G**

After inputting the pile section width, press  to calculate the other parameters. These parameters are:

**A** total area, which is the area defined by the outside perimeter

**A'** effective area, which is different from the total area (for H-Pile, the effective area is the steel section area)

**Perimeter** perimeter of section

**I'** effective moment of inertia

**E** elastic modulus

**Weight** weight of the section per unit length



**Hint:** Pressing the  button will calculate the other parameters automatically based on width. You can also modify the data directly.

**Step 8. Diameter Variation**

Allows the user to configure the shape along the length of the pile. Choose from **straight**, **belled**, **tapered**, or **plate**.

|                 |                                                                                                                                                                                                                                                                                                                         |
|-----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Straight</b> | For most pile with straight section                                                                                                                                                                                                                                                                                     |
| <b>Belled</b>   | For belled pile. You need to input two sections to define a bell. Input the diameter where the bell starts and select the <b>[Belled]</b> feature. Input a large diameter at where the bell ends and select the <b>[Straight]</b> feature. (Refer to sample 3 & 4)                                                      |
| <b>Tapered</b>  | For timber pile or any tapered pile. A tapered pile starts off with a large diameter at the top and a smaller diameter at the bottom of the pile. Select <b>[Tapered]</b> feature at the top of the pile with a larger diameter. Select <b>[Straight]</b> in the next section with a smaller diameter (Refer sample 12) |
| <b>Plate</b>    | For steel or concrete uplift plate. Select <b>[Plate]</b> at the depth where the plate is to be located. (Refer to sample 17 & 18)                                                                                                                                                                                      |

**Step 9. Close Screen**

If you are satisfied with your data, press **[Apply]** to close the screen and post the data to the Pile Property table (Figure 4-4). **[Cancel]** closes screen but does not save the data.

**HINT:**

**If you already have data in Pile Property Table (Fig 4-4) and do not want data to be overwritten by Pile Section Screen (Fig 4-5), then you should click on [Cancel]**

**4.4.3 Effective Area and Total Area**

For pile analysis, the effective area and total area is used according to the pile type. The effective area ( $A'$ ) defined by the section area, is commonly used in pile shaft compression calculations, whereas, the total area ( $A$ ) defined by the outside perimeter, is used for tip resistances calculations.

**H-Pile ( $A > A'$ ):**

$A$  = width x height

$A'$  = is the steel net area

**Concrete Pile with steel bar ( $A < A'$ ):**

$A$  = section area of the pile

$$A' = A_{\text{Concrete}} + A_{\text{Steel}} \times \frac{E_{\text{Steel}}}{E_{\text{Concrete}}}$$

Steel Hollow Pipe Pile ( $A > A'$ ):

$A$  = Total outside circular area

$A'$  = Net area of Steel

For open pipe piles, tip area is  $A'$ ,

For close pipe piles, tip area is  $A$

Seal Pipe Pile Filled withConcrete ( $A > A'$ ):

$A$  = total outside circular area

$$A' = A_{\text{seal}} + A_{\text{concrete}} \times \frac{E_{\text{concrete}}}{E_{\text{steel}}}$$

The same relations can be used for the moment of Inertia ( $I$ ) and ( $I'$ ).

#### 4.4.4 Shallow Footing

If you have selected shallow footing as pile type, the pile section screen will be as shown in Figure 4-6.

**Pile Section Screen - from pile top: 0 -ft**

Base Shape

☐ Square (D)
 ☐ Circle (D)
 ☒ Rectangular (D, B)
 ☐ Strip footing (B=1 ft or 1 m)

L - Input in Profile Page  
 Th - Thickness  
 Ha - Distance to Hard Layer.  
 Leave blank if unknown. Program will try to search it based on  $N_{spt} > 50$ .

Base Friction Factor: 0.6

Apply Cancel

Width (D) -in: 48 Area in2: 48.0 Length (B) -in: 1 Thick. (Th) -ft: 3 Ha -ft: 30 Weight -kip/ft: 0.000

**Figure 4-6.** Shallow Foundation Screen

Listed below are the items to be inputted:

- |                             |                                                                                                                                                                                    |
|-----------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Depth of Footing (L)</b> | This value is inputted in the pile profile page.                                                                                                                                   |
| <b>Shape</b>                | Select the shape of footing base. D is the width. B is the length. The lateral force act perpendicular to B. B can be larger or smaller than D. For strip footing, input B=1 ft or |

1 meter.

|                                    |                                                                                                                                                                                                                                                                                                                                                                                          |
|------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Thick (Th)</b>                  | The thickness of the footing used to calculate its' weight                                                                                                                                                                                                                                                                                                                               |
| <b>Distance to Hard Layer (Ha)</b> | If a hard layer exists below the base of the footing within four times D, settlement will be significantly reduce. User can leave this box blank or input <b>999</b> if Ha is at great depth or there is no hard layer. When this field is left blank, the program will automatically search for a hard layer. The program will consider a soil layer to be hard if the $N_{spt} > 50$ . |
| <b>Weight</b>                      | Weight of the footing section. Same as the weight in pile properties screen                                                                                                                                                                                                                                                                                                              |
| <b>Area</b>                        | The total area of the base                                                                                                                                                                                                                                                                                                                                                               |
| <b>Base Friction Factor</b>        | Factor required to calculate the friction against sliding at the base of the footing.<br><br>Cast-in-place footing (rough): factor of 0.6 to 1 (typical value is 0.7)<br><br>Pre-cast with small surface: factor of 0.3 to 0.6 (typical value 0.4 is used)                                                                                                                               |

## 4.5 Pile No. and Loading

You can start off by selecting the pile configuration that most fits the analysis.

Select **single pile**, **group pile** or **tower foundation** analysis (Figure 4-6) from the tabs on the left side of the panel.

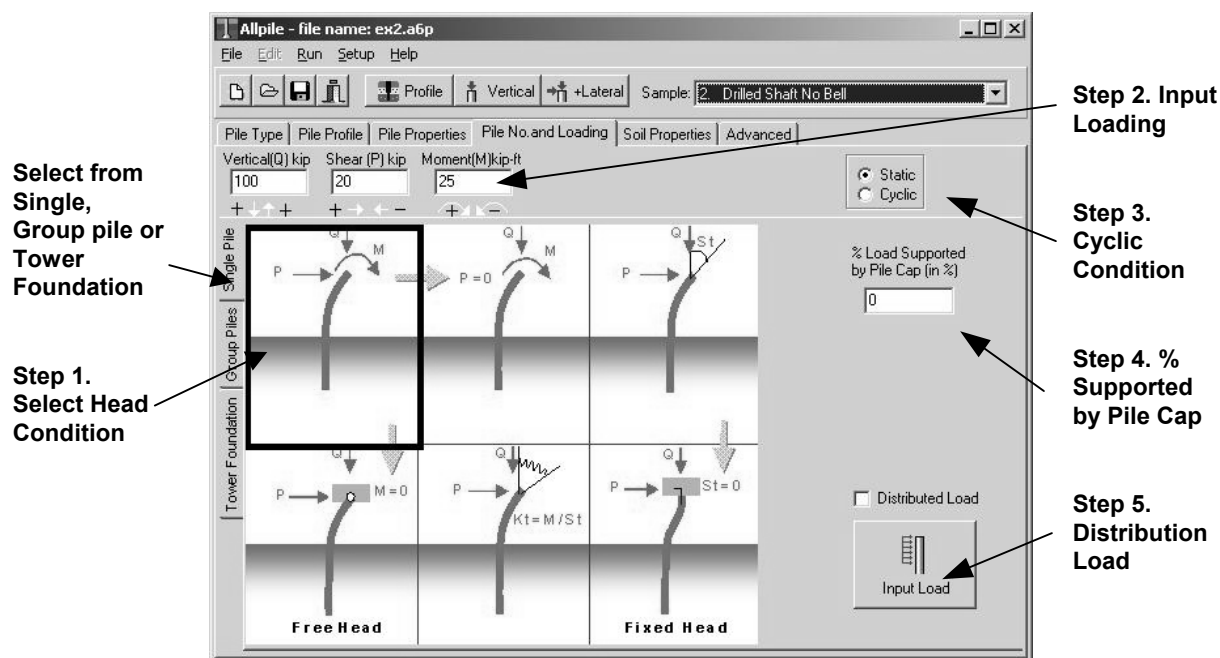


Figure 4-6. Group/Head/Load Page (Single Pile)

### 4.5.1 Single Pile

Click on the Single Pile tab if you want to perform analysis of one pile, then follow the steps below:

#### Step 1. Head Conditions for Single Pile

Single Pile has six possible head conditions as shown in Figure 4-6, click on the condition that best suits your project. The conditions are described below:

1. **P, M** The head of the pile can freely rotate under lateral shear load  $P$  and moment  $M$ .
2. **P, M=0** This condition is a special case of condition 1 where moment  $M$  is zero. Only lateral shear load ( $P$ ) is acting on the pile (commonly called free-head condition).
3. **P=0, M** Shear load is zero and only moment is acting on the pile top, a special case of condition 1.
4. **P, Kt**  $Kt$  is head rotation stiffness in moment per unit slope (useful for some structural analyses). Input  $Kt$  along with  $P$ . If  $Kt=0$ , then it is the same as condition 2 above ( $P, M=0$ ).
5. **P, St**  $St$  is the top rotation in degrees. Input  $St$  to force the pile head to rotate to a certain degree.
6. **P, St=0** Commonly called fixed-head, there is no rotation in the pile head, since  $St=0$ . Moment will be generated at the pile head.

**NOTE:** All the conditions can be combined with vertical load ( $Q$ ).

#### Step 2. Load Conditions for Single Pile

Based on the head conditions, there are many combinations of loads. The program automatically selects load combinations based on the head condition selected. Possible loads are:

**Vertical load (Q)** – Downward and uplift working load at pile top. Input a negative value for uplift load. The program will calculate both downward and uplift capacity in the vertical analysis.

**Shear load (P)** – Lateral working load at pile top. Positive value of  $P$  is from left to right, and negative value is from right to left.

**Moment (M)** – Working moment on the pile head. A positive value if  $M$  is clockwise and a negative value if  $M$  is counterclockwise.

**Slope (St)** – The known slope angle at the pile head. Negative value is clockwise and positive value is counterclockwise (unit is deflection/length).

**Stiffness (Kt)** – The rotation stiffness  $Kt$  is the ratio of moment/slope ( $M/St$ ). Negative value is clockwise and positive value is counterclockwise (unit is the same as  $M$ ).

#### Step 3 Cyclic Conditions



Select **Static** or **Cyclic** shear load. If the load is cyclic, specify the number of cycles in the **No. of Cycles** box (between 2 and 500).

**NOTE:** The cyclic condition only applies to lateral analysis, not vertical.

#### Step 4 Percentage Load Supported by Pile Cap

You can adjust the amount of vertical load carried by the pile cap. For 0% load supported by the pile cap, the entire load is transfer to the pile therefore dissipated by the pile at greater depth. For 100% load supported, the entire load is supported by the pile cap.

**Note:** To be conservation using 0% is recommended.

#### Step 5 Distributed lateral loads

To distribute load along the length of the pile press the **[Input Load]** button to open the panel shown in Figure 4-7. In the Distributed Load table, enter the following information:

- Z** The starting point of the distributed load, z is the distance from the pile top.
- Pq** Pq is distributed load along pile length at the z location.
- B** B is the width of the pressure.

**Note:** To apply the distributed load, the check box above the **[Input Load]** button must be checked

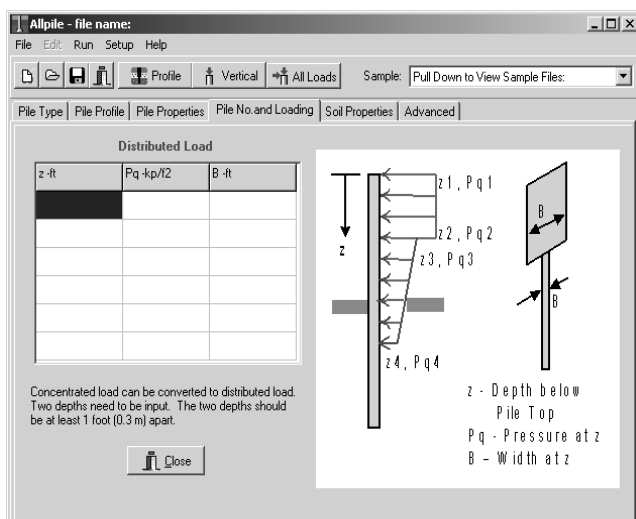


Figure 4-7. Distributed Load

The following examples illustrate how data are to be inputted in the table:

##### Example 1:

A signal post is 6ft wide and 8ft high above ground. A pile 1.2 ft in diameter supports it below ground. Wind pressure is 1.5 ksf. You can input  $z=0$  ft,  $pq=1.5$ ksf,  $B=6$  ft in the first row, and  $z=8$  ft,  $Pq=0$ , and  $B=1.2$ ft in the second row.

##### Example 2:

If a lateral pressure load of 1 kip per square foot (1 ksf or 1 kip/ft<sup>2</sup>) acting on a 2ft high pile shaft (dia = 1.5 ft), you can input  $z=2$ ft  $Pq=1$ ksf and  $B=1.5$ ft.

##### Example 3:

If a lateral load of 1kip per linear foot (1 kip/ft) is acting on the pile diameter (diameter = 1.5 feet), you should input  $Pq=1$  ksf and  $B=1$ .

## 4.5.2 Group Piles

Group analysis lets you select two head conditions under compressive, shear, moment, and torsion loading with unlimited number of piles. The analysis provides settlement, rotation, and lateral movement of the pile cap under these loadings. You can select the head condition that best fits your condition.

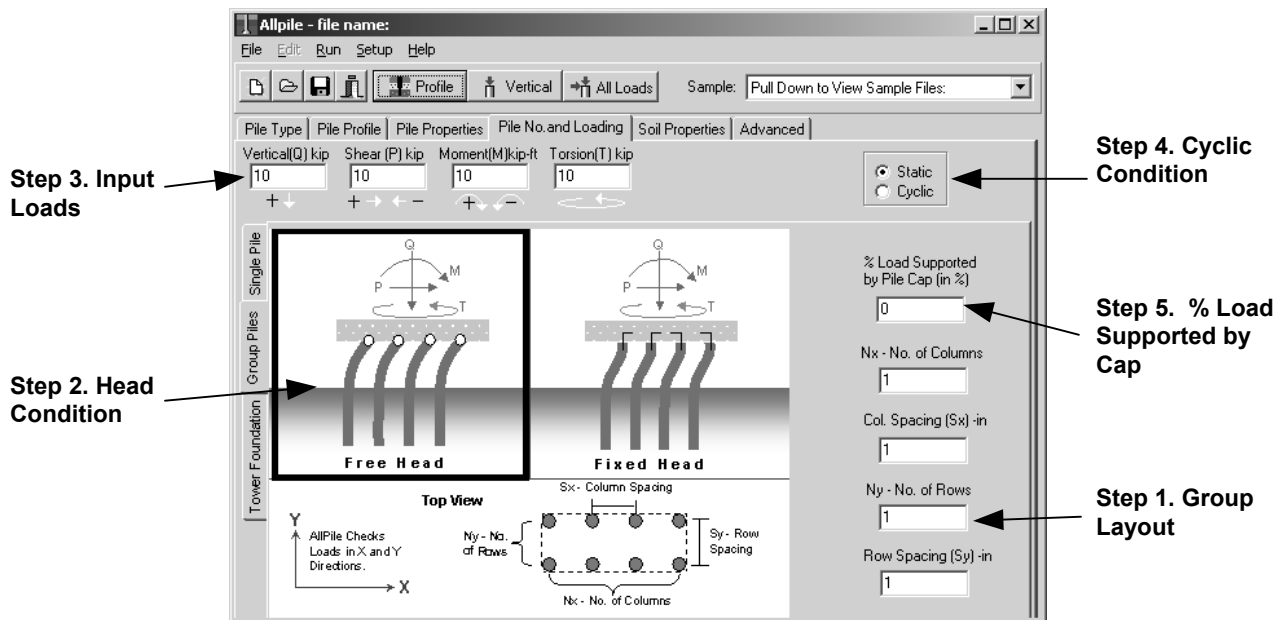


Figure 4-8. Pile No. &amp; Loading Page

**Step 1 Group Pile Layout**

Assuming the lateral load (P) is acting in X direction, as shown in Figure 4-8, the following data are required for group configuration:

|                               |                                                                  |
|-------------------------------|------------------------------------------------------------------|
| <b>Number of Columns (Nx)</b> | Input number of piles in X direction                             |
| <b>Column Spacing (Sx)</b>    | Input pile spacing in X direction measured from center of piles  |
| <b>Number of Rows (Ny)</b>    | Input number of piles in Y direction (perpendicular to the page) |
| <b>Row Spacing (Sy)</b>       | Input pile spacing in Y direction measured from center of piles  |

**Step 2 Head Conditions for Group Piles**

The piles within a group have two possible head conditions as shown on Figure 4-8.

- 1. Free Head** Referred to as **Free Head** condition. The top of each pile can freely rotate. Pin or hinge connections are assumed between pile cap and piles.
- 2. Fixed Head** Referred to as **Fix Head**, there is no rotation in the pile head. The pile and pile cap are fixed. Moment will be generated at the pile head.

**Step 3 Load Conditions for Group Piles**

Four load conditions apply to a set of group piles:

**Vertical load (Q)** – Downward and uplift working load at pile cap, equally distributed to all piles in the group. *Input a negative value for uplift load.*

**Lateral load (P)** – Lateral working load at pile cap. Positive value of P is from left to right, and negative value is from right to left. Load will be distributed to all piles in the group based on their lateral stiffness.

**Moment (M)** – Moment generated at the pile cap. Positive value of P is clockwise and a negative value is counterclockwise. There are no moments at the tip of each pile individually due to the fixation of head by the pile cap.

**Torsion (T)** – Torsion generated at the pile cap. Twisting of the pile cap due to external load.

#### Step 4 Cyclic Conditions

Select **Static** or **Cyclic** shear load. **No. of Cycles** (between 2 and 500). Only for lateral analysis

#### Step 5 Percentage of Load Supported by Pile Cap

You can adjust the amount of vertical load carried by the pile cap. For 0% load supported by the pile cap, the entire load is transfer to the pile therefore dissipated by the pile at greater depth. For 100% load supported, the pile cap supports the entire load.

**Note:** To be conservative using 0% is recommended.

### 4.5.3 Tower Foundation

Tower foundation analysis is similar to the other analyses, where you get to specify a head condition under compression, shear, moment, and torsion. It is assumed all piles have equal spacing in x and y direction. You can choose from fix head, free head or no pile cap. The user will also be asked to input the number of piles they want for the analysis (up to 4 piles).

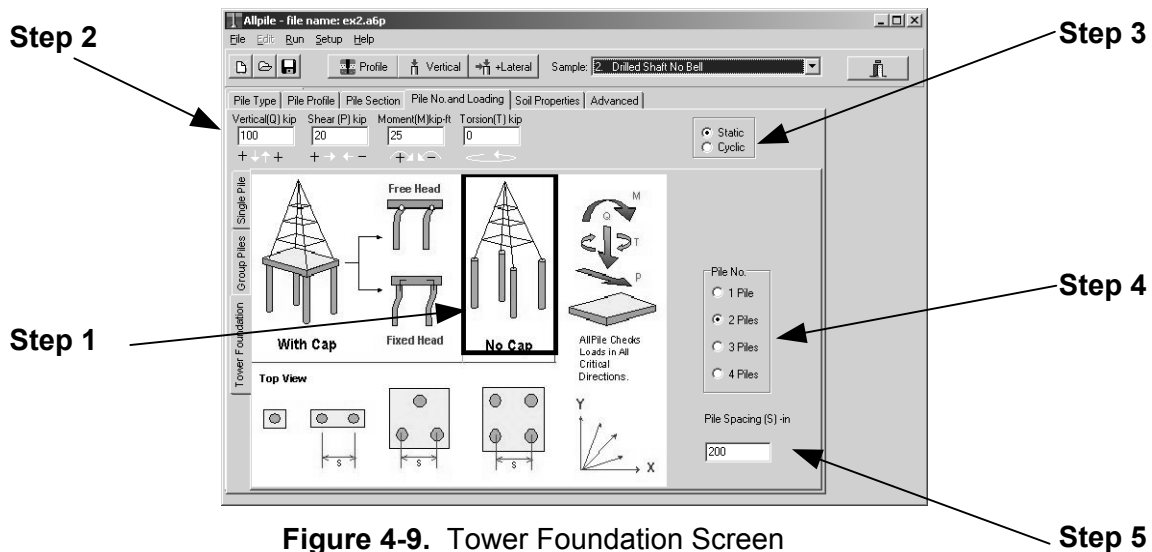


Figure 4-9. Tower Foundation Screen

#### Step 1 Select Head Condition

Select from the three head condition as described below:

##### Free Head

Top of the pile can freely rotate. Pin or hinge connections are assumed between pile caps and piles.

##### Fixed Head

There are no rotation in the pile cap. Piles and pile cap are fixed. Moment will be generated at the pile head.

**No Cap**

There is no pile cap to connect each pile.

**Step 2 Load Conditions for Group Piles**

Four load conditions apply to a set of group piles:

**Vertical load (Q)** – Downward and uplift working load at pile cap, equally distributed to all piles in the group. *Input a negative value for uplift load.*

**Shear load (P)** – Lateral working load at pile cap. Positive value of P is from left to right, and negative value is from right to left. Load will be distributed to all piles in the group based on their lateral stiffness.

**Moment (M)** – Moment generated at the pile cap. Positive value of P is clockwise and a negative value is counterclockwise. There are no moments at the tip of each pile individually due to the fixation of head by the pile cap.

**Torsion (T)** – Torsion generated at the pile cap. Twisting of the pile cap due to external load.

**Step3 Cyclic Conditions**

Select **Static** or **Cyclic** shear load. **No. of Cycles** (between 2 and 500). This information is for lateral analyses only.

**Step 4 Pile Number**

The total number of piles under a tower.

**Step 5 Pile Spacing**

The spacing between piles are assumed to be equal. Spacing has to be input in inches or cm. It is assumed x and y direction have the same spacing.

## 4.6 Soil Property Page

The Soil Property page (Figure 4-10) allows you to input water and soil information in four easy steps.

You must have a separate layer at water table location.

Input total unit weight above GWT, and buoyant unit weight below GWT

| Top Depth-ft | Soil Data Input         | G-lb/ft3 | Phi  | C-kp/ft2 | k-lb/ft3 | e50 or Dr | Nspt |
|--------------|-------------------------|----------|------|----------|----------|-----------|------|
| 0            | Medium dense silty S    | 117.4    | 34.2 | 0.00     | 61.4     | 40.67     | 13   |
| 5            | Very stiff clayey SI    | 132.7    | 33.0 | 1.26     | 819.5    | 0.57      | 20   |
| 12           | Medium dense fine SA[W] | 60.0     | 37.4 | 0.00     | 81.7     | 60.29     | 25   |
| 18           | Hard silty CLAY[W]      | 75.5     | 0.0  | 4.39     | 1655.2   | 0.41      | 35   |
| 25           | Hard CLAY[W]            | 77.3     | 37.2 | 2.99     | 2350.4   | 0.34      | 48   |
|              | Click to Open           |          |      |          |          |           |      |
|              | Click to Open           |          |      |          |          |           |      |
|              | Click to Open           |          |      |          |          |           |      |
|              | Click to Open           |          |      |          |          |           |      |
|              | Click to Open           |          |      |          |          |           |      |

Tip resistance based on stratum from pile tip extend to 10 time of pile diameter (10 recommended).

Figure 4-10. Soil Property Page

### Step 1 Ground Water Table (GWT)

Input the ground water table (GWT) depth (distance from ground surface). If the water table is deeper than the pile tip or at great depth, leave the box blank. Stratigraphy that are below GWT will appear in blue with a [W] beside the name.



**HINT:** Input the water table depth before completing the Soil Property table. Leave the box blank if there is no water or water is at great depth.

### Step 2 Soil Property Input

You can input up to ten layers, if the GWT exist within a layer, you must break the layer into two layers at the water table location. The total unit weight should be use for soil above the GWT, but the buoyant unit weight should be used for soil below the GWT. **You should input all the data through the Soil Parameter screen shown in Fig. 4-11.**

#### Top Depth

Input the top depth of the soil layer. The top is the distance from ground surface to the top of the layer. The depth of the first row (layer) is zero. The top of the second layer is the bottom of the first layer. The top depth of the last layer is defined as the last row. The bottom depth of the last layer is undefined, assuming it extends to a great depth.

#### Soil Data Input

Press the [Click to Open] button in the cell to open the Soil Parameter screen (see next section).

**HINT:** It is recommended to input all soil parameters



on the Soil Parameters screen (Figure 4-11).

|                             |                                                                                                                                                                                                                                                                                                                                                                  |
|-----------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>G</b>                    | Unit weight of soil. If the soil is under the water table, buoyant weight must be input. (This is why it is necessary to divide a layer into two if the GWT sits within this layer.) Buoyant weight is the total unit weight of the soil minus the unit weight of the water.<br><br><b>HINT: Input total unit weight above GWT and buoyant weight below GWT.</b> |
| <b>Phi</b>                  | Friction angle of soil.                                                                                                                                                                                                                                                                                                                                          |
| <b>C</b>                    | Cohesion of soil.                                                                                                                                                                                                                                                                                                                                                |
| <b>K</b>                    | Modulus of Subgrade Reaction of soil (for lateral analysis only). If you only run vertical analysis, you don't have to input this value (Refer to Ch.8 for description).                                                                                                                                                                                         |
| <b>e<sub>50</sub> or Dr</b> | If soil is silt, rock, or clay, e <sub>50</sub> is strain at 50% deflection in p-y curve (only used for cohesive soil in lateral analysis) (Refer to Ch.8). If soil is sand, Dr is the relative density from 0 to 100 (%). It is for reference only and is not used in the analysis.                                                                             |
| <b>Nspt</b>                 | Standard Penetration Test (SPT) value or N value is the number of blows to penetrate 12 inches in soil (304.8 mm) with a 140-lb (622.72 N) hammer dropping a distance of 30 inches (0.762 m).                                                                                                                                                                    |

**HINT: for more detail on k and e<sub>50</sub>, refer to Chapter 8, Lateral Analysis.**

### Step 3 Select Tip Stratum

Tip resistance calculation is based on the soil properties at pile tip. There may be several very thin layers under the tip. If the stratum is not defined (as zero), the first layer below the tip will control the results. Users should define a stratum thick enough to include all the influence layers. 10 times pile diameter is recommended. This will provide more reasonable results and also smooth the pile capacity vs. pile length curve.

### Step 4 Ground Elevation

It is optional to input a value in this field. If an elevation is inputted, the depth of the pile is shown on the left side and the elevation is shown on the right side of the chart.

**Soil Parameter Screen - from ground surface: 3 -ft**

☐ Soft Clay ☒ Stiff Clay ☐ Silt ☐ Sand ☐ Rock ☐ User Defined p-y

Above Water Table    Static Loading    Depth: 3    Description: Stiff Clay

V\_Soft | Soft | Medium | Stiff | Very Stiff | Hard

N (spt)=10    0 5 10 15 20 25 30 35 40 45 50 55 60    ☒ Links

G=129.2 lb/ft3    30 40 50 60 70 80 90 100 110 120 130 140 150    20.3 kN/m3

Friction=0.0    0 5 10 15 20 25 30 35 40 45 50

C=1.25 kip/ft2    0 0.5 1 1.5 2 2.5 3 3.5 4 4.5 5    59.85 kN/m2

K=313.1 lb/in3    0 200 400 600 800 1000 1200 1400 1600 1800 2000    85.0 MN/m3

e50=0.87%    0 0.25 0.5 0.75 1.0 1.25 1.5 1.75 2.0 2.25 2.5

This Screen is Copyright© protected by CivilTech Software   

**Step 1 Select Soil Type** (points to Stiff Clay)

**Step 2 Adjust N(spt) slide bar** (points to N (spt)=10)

**Step 3 Fine tuning other parameters** (points to G, Friction, C, K, e50 sliders)

Figure 4-11. Soil Parameter Screen

### 4.6.1 Soil Parameter Screen

The Soil Parameter screen (Figure 4-11) is for inputting or modifying the soil parameters. The program provides correlation between N value (SPT value) and the other parameters (refer to Chapter 8 for details). You can move the N sliding bar to modify all the parameters or move each bar individually.

The following steps show how to use this screen.

- Step 1**      Select material: soft clay, stiff clay, silt, sand or rock (including concrete) and p-y input.
- Step 2**      Move the N bar to the desired value. If the **LINK** check box is checked the other bars will move correspondingly. If the box is unchecked, the other parameters will not be affected when moving the N(spt) slide bar.
- Step 3**      Fine tune the other sliding bars to get parameters that best suits your geology. Changes will not affect the other values if you alter the slide bars of other parameters other than N value.
- Step 4**      If you are finished with the input process, close the screen by clicking [**APPLY**]. The data will be display on the Soil Property table. (If you press [**Cancel**], the data will not be posted.)

**NOTE:**



- The related properties selected from the N value are only recommendations. Users should use their engineering judgment to adjust the parameters.
- Users should input the water table first. The parameters related to N value are different above and below the water table.
- If the user has a known parameter, the N value bar can be moved until the known parameter reaches its value, therefore getting the other corresponding parameters for the soil.

*p-y Curve Input*

You can customize the p-y curve for the soil type or use the system default p-y relation. From the Soil Parameter Screen, check the p-y input box on the upper right corner of the panel. Then click on **[Input p-y curve]**. The p-y input screen is shown in Figure 4-12. If you would like to modify the p-y curve from the previous layer, it can be copied by clicking on the **[Copy from previous row]** button. The values will be amplified if the user enters a multiplier in the **Copy Factor** field.

Soil Parameter Screen - from ground surface: 15 -ft

| No. | y-in | P-lb/i |
|-----|------|--------|
| 1   | 0    | 0      |
| 2   | .2   | 66.1   |
| 3   | .4   | 83.2   |
| 4   | .8   | 105    |
| 5   | 1.2  | 120    |
| 6   | 6    | 0      |
| 7   |      |        |
| 8   |      |        |
| 9   |      |        |
| 10  |      |        |
| 11  |      |        |
| 12  |      |        |
| 13  |      |        |
| 14  |      |        |
| 15  |      |        |
| 16  |      |        |
| 17  |      |        |

Input P-Y Points  
Minimum 2 Points,  
Maximum 17 Points.

Copy PY from upper Soil

Copy Factor: 2

Show Graphical Curve

Apply

Cancel

Input p-y Curve

dense silty SAND (Glacial till)

Very Dense

Links

5.6 kN/m3

0.00 kN/m2

0.5 MN/m3

Apply

Cancel

**Figure 4-12.** User define p-y Input

After you are satisfied with the entry, clicking on **[Show Graphical Curve]** will give you the corresponding curve. Click **[Apply]** to accept the data inputted or click **[Cancel]** to exit screen without accepting changes.

**NOTE:**

The system will generate a p-y curve based on the k and  $e_{50}$  value selected on the soil parameter screen. Once the user input their preferred p-y curve values and the box is checked, the k and  $e_{50}$  will be ignored in the analysis. If p-y is inputted and the box is unchecked, the program uses the default p-y.

## 4.7 Advanced Page

This page allows the user to assign analysis parameters. More details are outlined in the following sections.

### 4.7.1 Zero Resistance and Negative Resistance (Downdrag Force)

#### *Zero Resistance*

The program handles zero resistance on the Advanced page (Figure 4-13). If a pile has a section that does not develop side resistance, this section has “zero resistance”. For example, a free anchor length of tieback anchor and a smooth caisson section of micropile are considered as zero resistance zones. If a pile penetrates through a cave, the cave portion is considered as a zero resistance zone. Up to two zero resistance zones can be defined in each case. To specify the zone of zero resistance, you must enter the depth of the zone measured from the top of the pile in (feet/meter). Zero resistance includes side and tip resistance.

**HINT:** You must check the check box to make the zone(s) be included in the calculation. See Chapter 8 for details.

#### *Negative Resistance*

If soils in the upper layers have significant settlement, the pile will experience downdrag force. This area is called negative resistance. The program handles negative resistance on the Advanced page (Figure 4-13). Up to two negative resistance zones can be defined.

“Factor” is the effective factor,  $K_{neg}$ . It ranges from 0 to 1 depending on the impact of soil settlement on the pile shaft. If the factor equals 1, then the negative friction is equal to the friction in the downward capacity analysis. If the factor equals 0, then there is no friction between pile and soils. It is the same as zero friction. If the pile has a smooth surface and the soil has small settlement,  $K_{neg}$  is in the range of 0 to 0.3. If the pile has a rough surface and the soil has a large settlement,  $K_{neg}$  is 0.3 to 0.6.

#### **HINTS:**



1. If  $K_{neg} = 0$ , there is no resistance between the pile and the soil, i.e., it is the same as zero resistance.
2.  $K_{neg}$  should be a positive value rather than using a negative value.
3. You must check the check box on the left side so that the calculation will take into account the negative resistance.
4. The negative resistance only applies to downward side resistance, not tip resistance. The induced downdrag force reduces the pile capacity in the analysis.

File Edit Run Setup Help

Profile Vertical +Lateral Sample: 9. Driving Steel Pile with Battered Angle

File Type | File Profile | **File Properties** | File No. and Loading | Soil Properties | Advanced

Zero Friction (Non-load zone) and Negative Friction (Downdrag force):

☐ Zero Friction from  to  ☐ Negative Friction from  to  Factor  1

☐ Zero Friction from  to  ☐ Negative Friction from  to  Factor  1

Analysis Parameters:

| Parameters: Value [1]: Value [2]                                                   | Value [1] | Value [2] |
|------------------------------------------------------------------------------------|-----------|-----------|
| FS for Downward: [1] FS_side; [2] FS_tip                                           | 1.5       | 2.0       |
| FS for Uplift: [1] FS_side; [2] FS_weight                                          | 2.0       | 1.0       |
| Load Factor: [1] Vertical,Q; [2] Lateral,P,M,T                                     | 1.0       | 1.0       |
| Critical Depth as Ratio of Diameter: [1] Side; [2] Tip                             | 20.0      | 20.0      |
| Limit of Max. Resistance: [1] Side; [2] Tip -k <sub>p</sub> /t <sub>2</sub>        | 9999.0    | 9999.0    |
| Allowable Deflection: [1] Vertical, x_allow [2] Lateral, y_allow -in               | 1.0       | 1.0       |
| Group Reduction Factor for Lateral Analysis: [1] R <sub>x</sub> [2] R <sub>y</sub> | 1.0       | 1.0       |

Settlement Calculation  
☒ Vesic Method ☐ Reese Method

Define p-y, t-z Output Depths

Figure 4-13. Advanced Page

### Analysis Parameters

For advanced users they can customize analysis parameters listed below:

|                                                   |                                                                                                                                                                                                                         |
|---------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| FS for Downward                                   | The factor of safety for downward capacity, including side resistance and tip resistance.                                                                                                                               |
| FS for Uplift                                     | The factor of safety for uplifting, including side resistance and the weight of the pile.                                                                                                                               |
| Load Factor                                       | The factor that is multiplied into the vertical load and lateral load.                                                                                                                                                  |
| Critical Depth as Ratio of Diameter               | The effect of overburden pressure increase with depth. The critical depth to which the pressure becomes constant is defined by the diameter of the pile.<br><b>Note:</b> A critical depth of 20D is recommended         |
| Limit of Max Resistance                           | A limit can be applied to the side and tip resistance.<br><b>Note:</b> To apply no limits to these values enter “9999”                                                                                                  |
| Allowable Deflection                              | The vertical settlement and lateral deflection limit. If any one of these values is exceeded, a warning message will be displayed.                                                                                      |
| Group Reduction Factor $R_{side}$ and $R_{front}$ | In lateral group analysis, pile lateral capacity is reduced by existence of a pile in front and a pile on side (based on spacing). User can input factor in addition to program calculated $R_{side}$ and $R_{front}$ . |

### Methods of Settlement Analysis

There are two methods for settlement analysis to choose from.

|              |                                                       |
|--------------|-------------------------------------------------------|
| Vesic Method | Method based on Vesic's publication in 1977.          |
| Reese Method | Method based on Reese and O'Neil publication in 1988. |

***Define p-y and t-z Output Depths***

Sometimes users might require p-y and t-z curves to be plotted out. Since the curves are different at different depths, users can define the depths at which the curves are to be generated. If the table is left blank, the program will automatically generate curves at depths of equal intervals.

## 4.8 Units of Measure

The unit for input data is presented in Table 4-1.

**Table 4-1 Units of Measure**

| Input Page of Program           | Item                           | Symbol         | English Unit                     | Metric Unit              |
|---------------------------------|--------------------------------|----------------|----------------------------------|--------------------------|
| Pile Profile                    | Pile length                    | L              | feet (ft)                        | m                        |
|                                 | Height (Pile top to ground)    | H              | feet (ft)                        | m                        |
|                                 | Surface slope angle            | As             | degrees                          | Degrees                  |
|                                 | Batter angle                   | Ab             | degrees                          | Degrees                  |
| Pile Property                   | From pile top                  | Z              | feet (ft)                        | m                        |
|                                 | Width                          | D              | inches (in)                      | cm                       |
|                                 | Area of section                | A              | square inches (in <sup>2</sup> ) | cm <sup>2</sup>          |
|                                 | Perimeter of section           | P <sub>i</sub> | in                               | cm                       |
|                                 | Moment of inertia              | I              | in <sup>4</sup>                  | cm <sup>4</sup>          |
|                                 | Modulus of elasticity          | E              | kip/in <sup>2</sup>              | MN/m <sup>2</sup> (MPa)  |
|                                 | Weight of pile section         | W <sub>i</sub> | kip/ft                           | KN/m                     |
| Pile Number and Loading         | Vertical Load                  | Q              | Kip                              | KN                       |
|                                 | Shear (Lateral Load)           | P              | kip                              | KN                       |
|                                 | Moment                         | M              | kip-ft                           | kN-m                     |
|                                 | Torsion                        | T              | kip-ft                           | kN-m                     |
|                                 | Lateral Slope                  | St             | in/in                            | cm/cm                    |
|                                 | Stiffness                      | Kt             | kip-ft/in/in                     | kN-m/cm/cm               |
| Distribution Load               | From pile tip                  | Z              | Ft                               | M                        |
|                                 | Pressure                       | P <sub>q</sub> | kip/ft <sup>2</sup>              | kN/m <sup>2</sup> (kPa ) |
|                                 | Width                          | B              | ft                               | M                        |
| Group Pile and Tower Foundation | % cap                          | Kcap           | percent                          | percent                  |
|                                 | Number of columns              | Nx             | --                               | --                       |
|                                 | Column spacing                 | Sx             | in                               | cm                       |
|                                 | Number of rows                 | Ny             | --                               | --                       |
|                                 | Row spacing                    | Sy or S        | in                               | cm                       |
| Soil Property                   | Water table depth from surface | GWT            | ft                               | m                        |
|                                 | Unit weight                    | G              | lb/ft <sup>3</sup>               | kN/m <sup>3</sup>        |
|                                 | Friction                       | Phi (φ)        | degrees                          | degrees                  |
|                                 | Cohesion                       | C              | kip/ft <sup>2</sup>              | kN/m <sup>2</sup> (kPa ) |
|                                 | Modulus of subgrade reaction   | k              | lb/in <sup>3</sup>               | MN/m <sup>3</sup>        |
|                                 | Soil strain or                 | E50            | percent                          | Percent                  |
|                                 | Relative density               | Dr             | percent                          | Percent                  |
|                                 | SPT Value                      | Nspt           | --                               | --                       |

# ***CHAPTER 5***

---

## ***RESULTS***

This chapter describes:

- The output of AllPile
- Some of the analyses you can perform with the program
- The results of the analyses

## 5.1 Profile

The **Profile** function provides the pile profile and soil conditions (Figure 5-1). This report also presents soil parameters as well as foundation material properties input by users. The report can be printed for references.

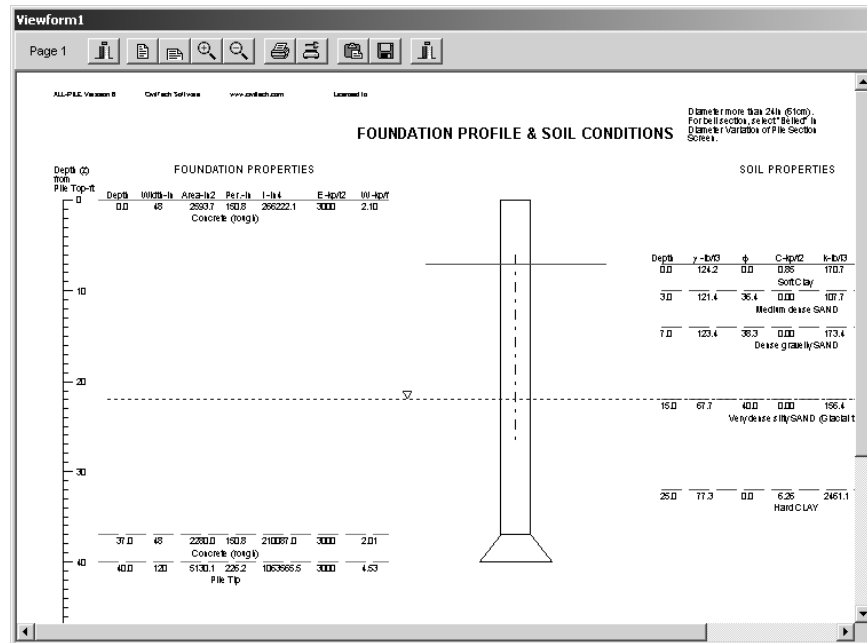


Figure 5-1. Profile Screen

## 5.2 Vertical Analysis Results

Clicking on [Vertical Analysis] will display a panel that allows you to choose the different types of result from the analysis. For this analysis all lateral load components are ignored and only vertical load is considered. Figure 5-2 shows the several choices available for vertical analysis.

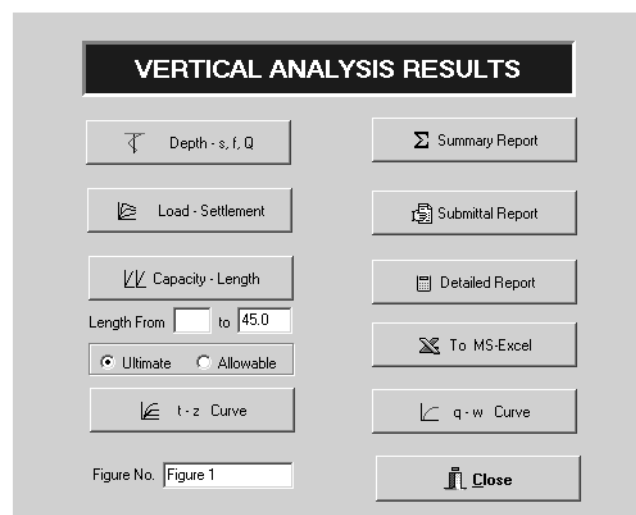


Figure 5-2. Vertical Analysis Results Panel

### 5.2.1 Depth (z) vs. s, f, Q

The program provides four diagrams in this report, as shown in Figure 5-3. Each diagram is explained below. (All the data is based on ultimate loading condition.)

#### V Stress (S)

Vertical stress (overburden stress) in the soil adjacent to the pile. The stress increases with depth (z) to a certain point and then becomes constant. This is because the overburden stress has a maximum limit. This limit can be modified on the Advanced page.

#### Skin Friction (f)

Upward and downward side resistances are the combination of friction and adhesion from soils.

#### Axial Force (Q)

Downward capacity and uplift are combined in one graph. The left portion of the graph defines the ultimate uplift capacity of the pile, whereas, the right side of the graph defines the ultimate downward (compression) capacity.

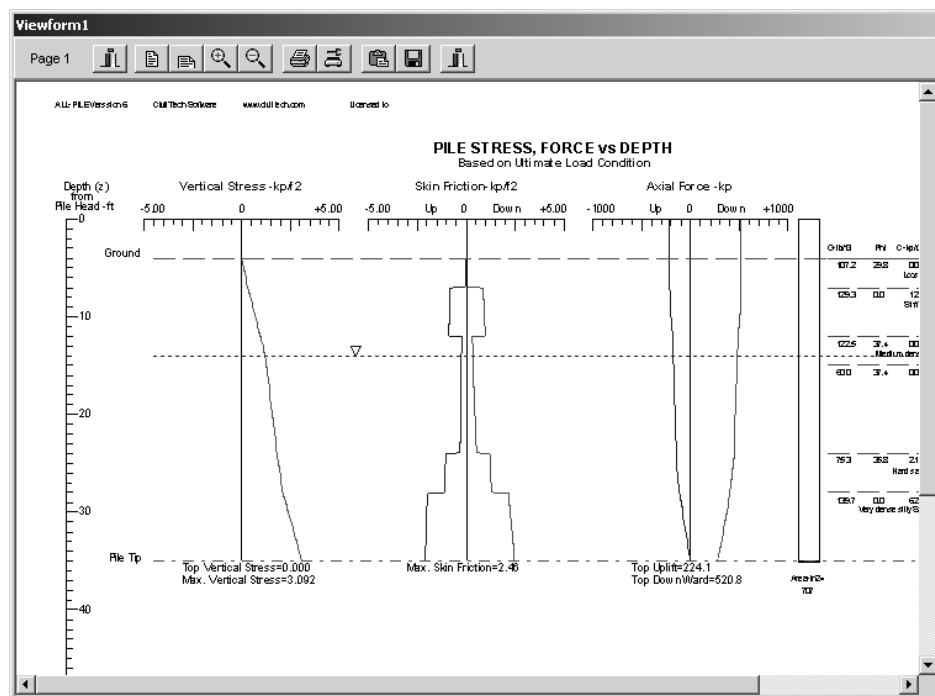


Figure 5-3. Depth vs. s, f, Q

## 5.2.2 Load vs. Settlement

By clicking on this button, you will get a graph of compression load vs. settlement of the pile/pile group. Three immediate settlement curves will be plotted. Settlement of the side is in blue, whereas, settlement of the tip is in red. Adding the two curves together will result in the total settlement, the black line on the graph. Note that the peak of side resistance is at a different location from peak of tip resistance.

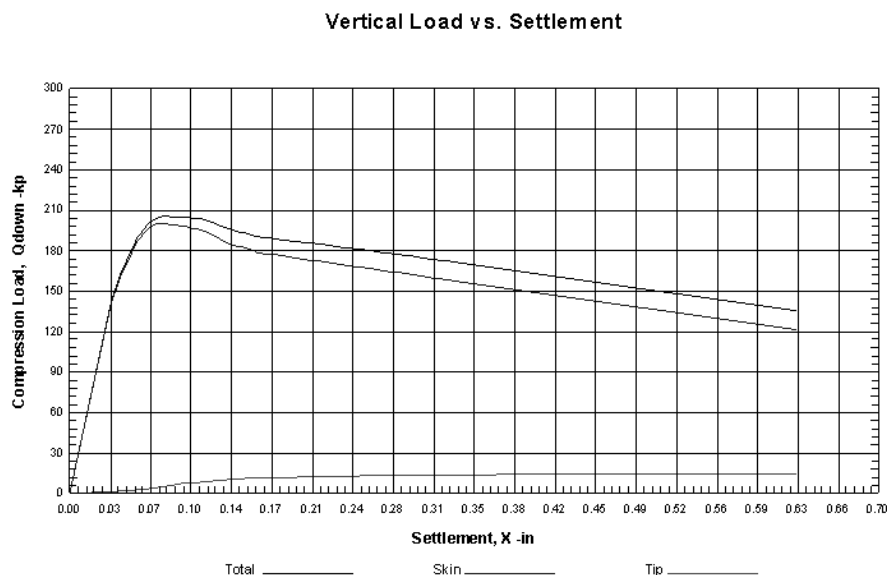


**Figure 5-3.** Vertical Load vs. Settlement Plot

## 5.2.3 Capacity vs. Length

Press the **[Capacity – Length]** button to get the two diagrams shown on Figure 5-4. One is the downward capacity ( $Q_d$ ) versus pile length ( $L$ ). The other is the uplift capacity ( $Q_u$ ) versus pile length ( $L$ ). The start and end lengths can be specified in the two boxes below the button. Users can also choose to generate graphs for ultimate capacity or allowable capacity by checking the corresponding box below the button. The Factor of Safety can be defined on the advanced page.



**NOTE:** This function only works for a single section pile. If the pile has more than one section, the resulted graph does not represent the actual condition.

## ULTIMATE CAPACITY vs FOUNDATION DEPTH

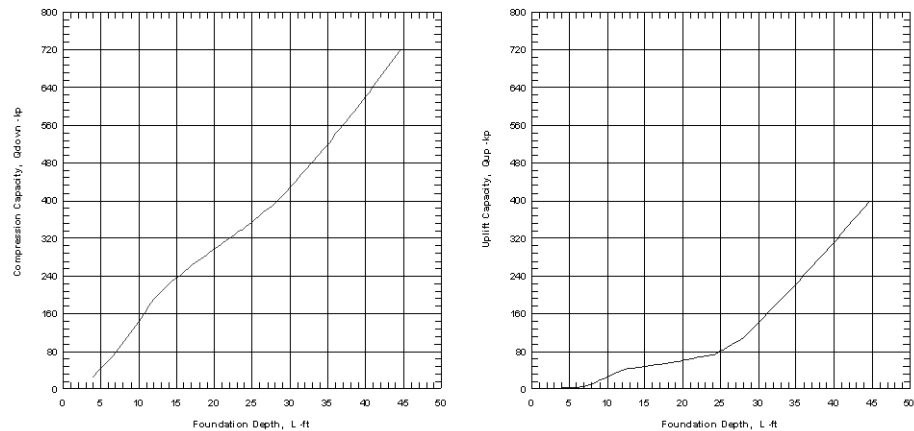


Figure 5-4. Capacity vs. Length

## 5.2.4 t-z Curve

When clicked on the **[t-z curve]** button, a t-z curve will be generated (Figure 5-5). This curve gives the skin friction along the depth of the pile. It is a function of relative movement between soil and pile. The t-z function can generate t-z curves at various depths. Users can define the depths at which these curves are to be generated on the **Advanced** page.

## Skin Resistance vs. Side Movement (t-z)

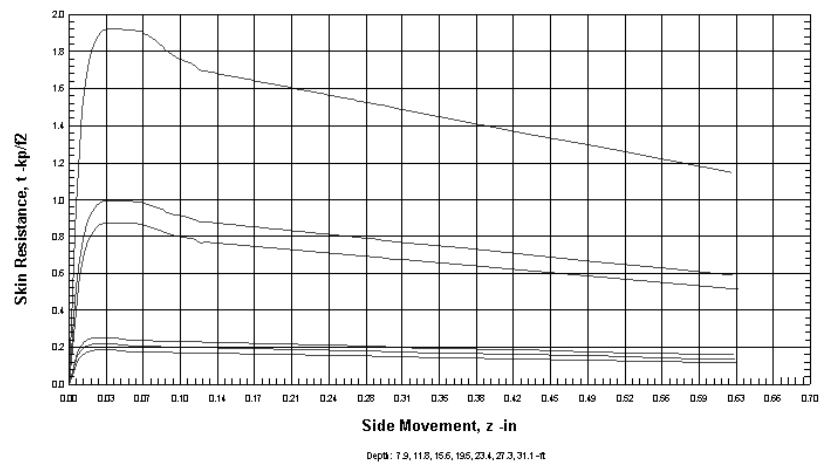


Figure 5-5. Skin Friction vs. Side Movement

## 5.2.5 q-w Curve

The q-w curve plots the tip settlement against the tip resistance. Figure 5-6 shows a plot of such curve.

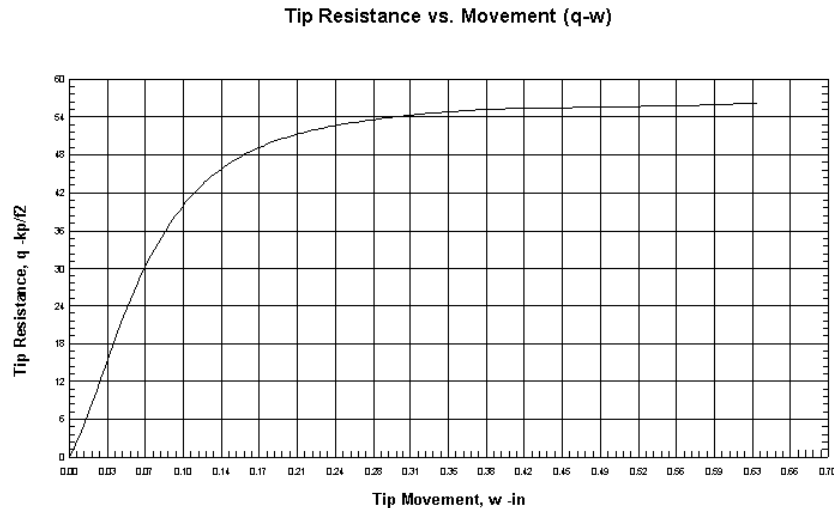


**Figure 5-6.** Tip Resistance vs. Tip Movement

## 5.2.6 Submittal Report

The formatted submittal report gives soil and pile physical parameters used in the analysis, as well as the calculated results for vertical analysis in an organized fashion. Presented here are the most important information required for pile design.

## 5.2.7 Summary Report

Summary report provides an unformatted summary of calculated results. The report is opened in Windows Notepad.



### HINTS:

- In the Notepad page, you can copy and paste data to other Windows programs, such as Word. The tabulated data are tab delimited, so they can be processed in Excel using Data/text to columns function. To export data directly to Excel, see "Exporting to Excel" below.
- If the report text is wrapped in Notepad, you can improve readability by selecting a smaller font by opening [Font] under the Format menu. We recommend using Courier New font size 8.

## 5.2.8 Detail Report

The calculation report presents the details of the calculation so that the user can check the correctness of the calculation and also understand how it is done. It is viewed in Notepad or Wordpad (for larger files).

## 5.2.9 Exporting to Excel

If you have Microsoft Excel 97 or 2000 installed on your computer, clicking on this button will launch a pre-designed Excel file called "Allpile.xls". If your Excel program has an option called Virus Macro Protection, you will see



a dialogue box when AllPile launches Excel. You should check the [**Enable Macros**] option to allow the operation to be continued.

After the Excel file is opened, on the first sheet (Data), there is a button called [**Update Vertical Data**]. Press this button to update data from AllPile. Then you can view graphics presented in the next few sheets. You can edit the graphics to customize your report, but do not change the structures and the settings of the Data sheet.

All the instructions are presented in the Excel file.

### 5.2.10 Figure Number

The figure number box allows you to input a figure/plate number or page number so that you can insert the graphic into your own report. The number you entered will be displayed on anyone of the above mentioned report. The format of the report and the company name and logo can be modified in the Setup/Options screen (refer to Chapter 6 for detail).

## 5.3 Lateral Analysis Results

The lateral analysis results panel (Figure 5-7) provides several choices.

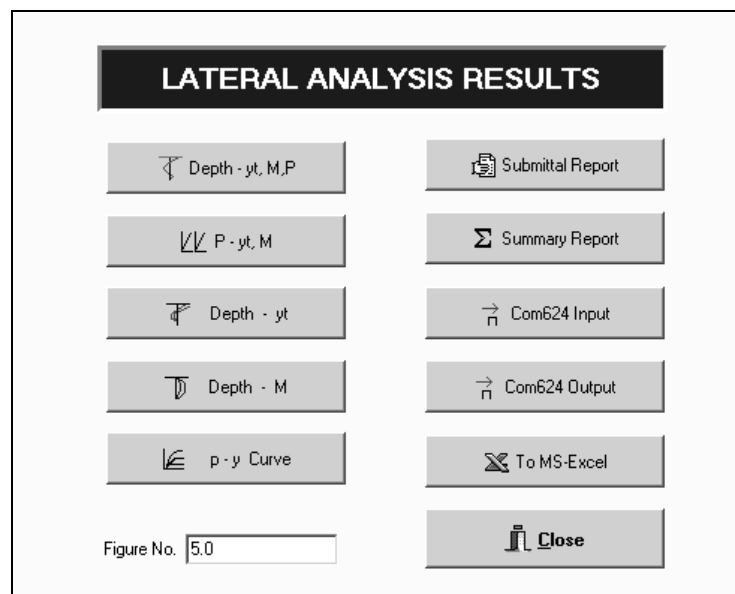


Figure 5-7. Lateral Analysis Results

### 5.3.1 Depth (z) vs. $y_t$ , M, P

The program provides 3 diagrams in the report, as shown in Figure 5-8.

|                                      |                                                                                     |
|--------------------------------------|-------------------------------------------------------------------------------------|
| <b>Deflection (<math>y_t</math>)</b> | Lateral deflection along the depth (z)                                              |
| <b>Moment (M)</b>                    | Bending moment in the pile shaft                                                    |
| <b>Shear (P)</b>                     | Shear force in the pile shaft. It equals the lateral load applied at the pile head. |

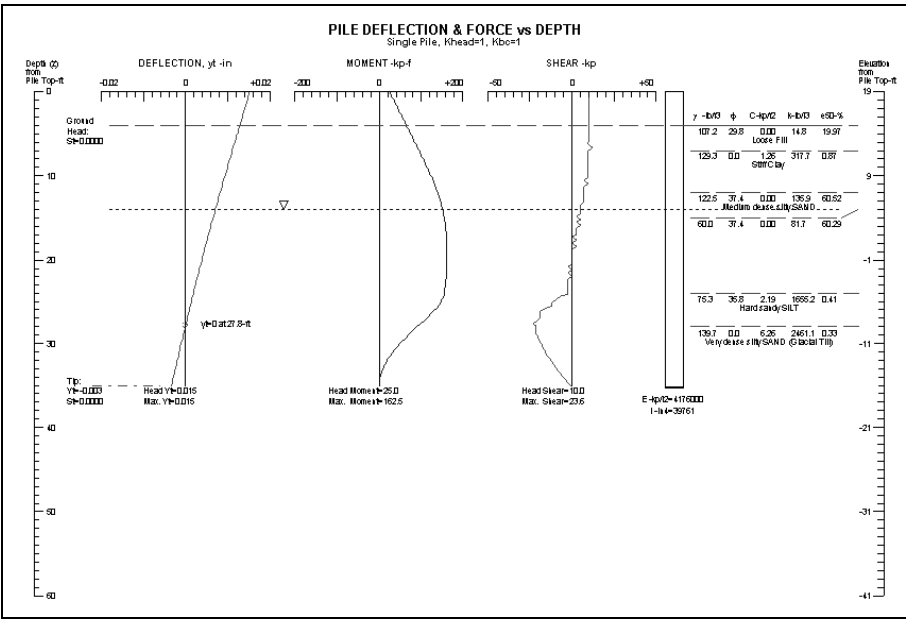


**Figure 5-8. Depth vs. yt, M, P**

### 5.3.2 Load (P) - $y_t$ , M

Click this button to get the two diagrams shown in Figure 5-9.

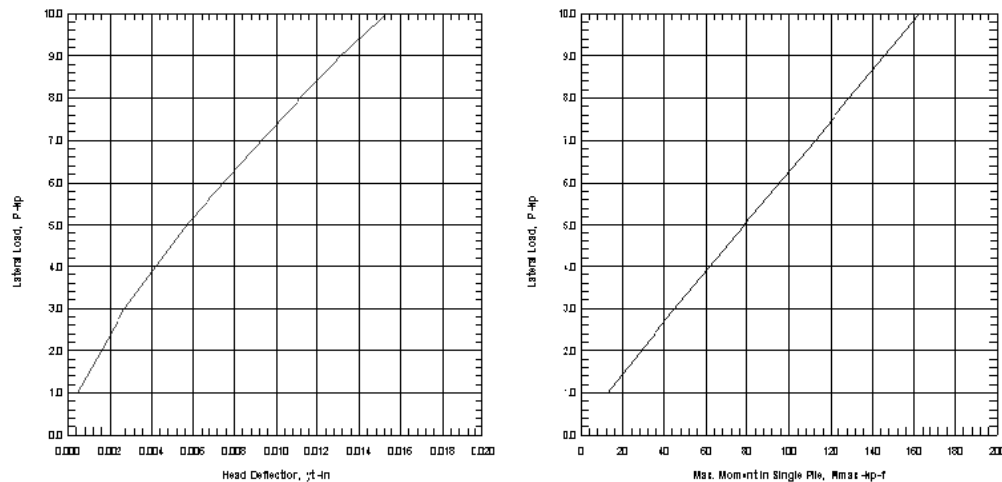
Lateral load (P) vs. head deflection (yt)

The diagram shows the pile head deflection under the lateral load at pile head.

Lateral load (P) vs. maximum moment (Mmax)

The diagram presents the maximum moment in the pile shaft under the lateral load at pile head.

### LATERAL LOAD vs DEFLECTION & MAX. MOMENT



### Figure 5-9. Lateral Load vs. Deflection & Moment

### 5.3.3 Depth vs. $y_t$

A series of deflection curves at increasing loading. The loading conditions of the different curves are presented on the table at the lower left corner of the report (Figure 5-10).

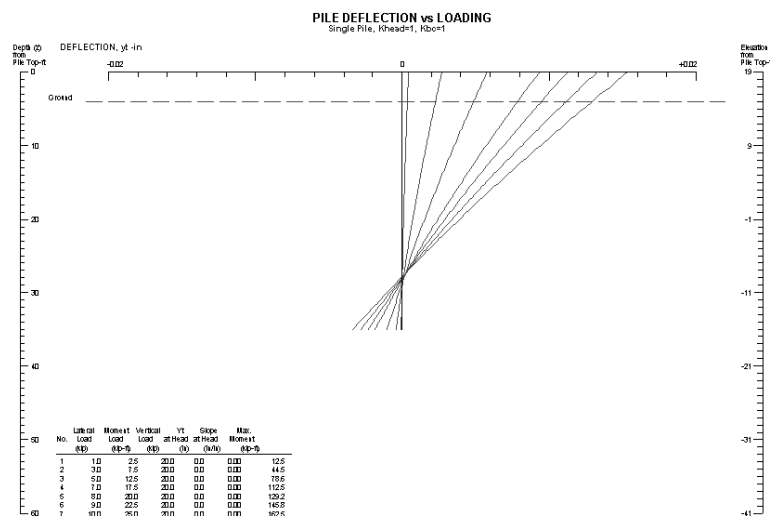


Figure 5-10. Depth vs. Deflection

### 5.3.4 Depth vs. M

A series of bending moment curves at increasing loading. Loading conditions are outlined in a chart at the lower left corner of the report (Figure 5-11).

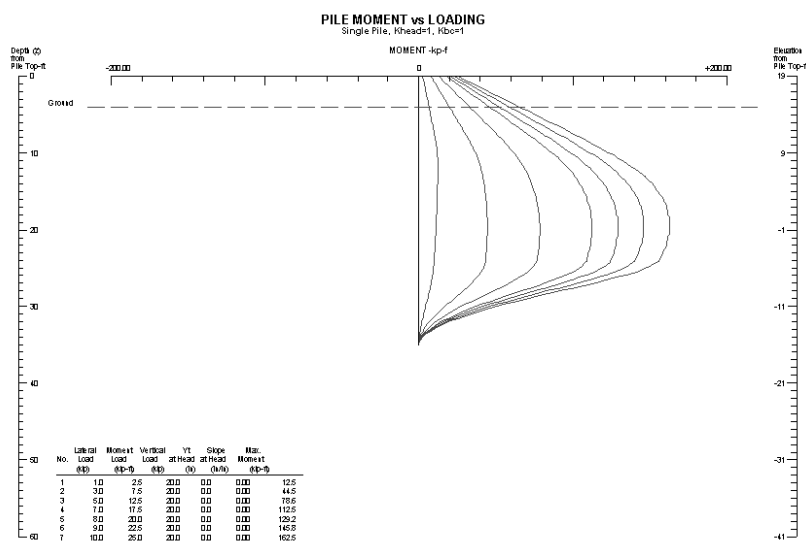


Figure 5-11. Depth vs. Moment

### 5.3.5 p-y Curve

A series of p-y curves at different depths. The depths are defined on the Advanced page.

### 5.3.6 Submittal Report

A report generated by the program that contains the most critical information for design. It extracts calculation results from Com624 Output and summarizes the information in this report.

### 5.3.7 Summary Report

Summary Report provides a summary of calculated results. The report is saved and opened in Windows Notepad. If the file is too large, Windows will automatically open the report in Wordpad instead of Notepad.



#### HINTS:

- In the Notepad page, you can copy and paste data to other Windows programs, such as Word. However, the tabulated data are spacing delimited, so they are not suitable for Excel. To export data to Excel, see "Exporting to Excel" below.
- If the report text is wrapped in Notepad, you can improve readability by selecting a smaller font by opening [Set Font] under the Edit menu. We recommend using Courier new font size 8.

### 5.3.8 Com624 Output/Input

The lateral is performed by uses the revised version of Com624P program embedded in AllPile. You can view a typical Com624P output report by pressing the button. You can also view the Com624P input file by pressing the Com624 Input button.



#### HINTS:

- If the program encounters some errors and cannot produce results, you should review the Com624 output. You can also directly run Com624P using the input file by the program.
- Com624 program and example files can be downloaded from the AllPile Section in CivilTech's website.

### 5.3.9 Exporting to Excel

If you have Microsoft Excel 97 or 2000 installed on your computer, clicking on this button will launch a pre-designed Excel file called "Allpile.xls". After the Excel file is opened, on the first sheet (Data) there is a button called [Update Lateral Data]. Press this button to update data from AllPile. You can view graphics presented on the next few sheets. You may edit the graphics, but do not change the structures or settings in the Data sheet. All instructions are presented in the Excel file.

### 5.3.10 Figure Number

The figure number box allows you to input a figure/plate number or page number so that you can insert the graphic into your own report. The format of the report and the company name and logo can be modified in the Setup/Options screen (refer to Chapter 6 for details).



## 5.4 Preview and Print Screen

The Preview and Print screen toolbar is shown below (Figure 5-9). The functions of all the buttons are described in the following text.



**Figure 5-9.** Preview Screen

The buttons are:

|                      |                                                                                                                                     |
|----------------------|-------------------------------------------------------------------------------------------------------------------------------------|
| <b>Close</b>         | Close Preview                                                                                                                       |
| <b>Page Height</b>   | Zoom to the page height                                                                                                             |
| <b>Page Width</b>    | Zoom to the page width                                                                                                              |
| <b>Zoom In</b>       | Enlarge the image                                                                                                                   |
| <b>Zoom Out</b>      | Reduce the image                                                                                                                    |
| <b>Printer</b>       | Send to printer                                                                                                                     |
| <b>Printer Setup</b> | Set up printer                                                                                                                      |
| <b>Clipboard</b>     | Copy the graphics to Windows Clipboard. Users can paste the graphics to any Windows program such as MS-Word, PowerPoint, and Excel. |
| <b>Save</b>          | Save graphics to a Windows metafile, which can be opened or inserted by other drawing programs for editing.                         |
| <b>Close</b>         | Close Preview                                                                                                                       |

## 5.5 Errors and Troubleshooting

### *Report Layout*

If the font, logo, and title are missing or misplaced in the report, most likely the setup file is damaged, or the setting parameters are out of range. You should open the Setup menu and restore to the manufacturer's settings. Please refer to chapter 6.

### *Vertical Analysis*

The program will check most input for errors before calculation. Typical errors are:

- Total unit weight instead of buoyant unit weight under water table. Buoyant unit weight should be input under water table.
- No data in pile properties such as width, area, I, and E.
- No data in soil properties such as G, Phi, and C.
- Setup file is damaged, or the setting parameters are out of range. You should open the Setup menu and check the values.

***Lateral Analysis***

The program uses a pre-processor of COM628P to perform lateral analyses. The codes within the program have been re-written to solve most of the problems when initiating COM624P in the previous version of this program. The problems that are related to execution or limitations of COM624P are:

- No COM624 output file! - Com624 computation encountered an error and the program did not produce output file.
- Error in Com624 computation! No Depth- $y_t$  data! - Com624 computation encountered an error and the program did not produce Depth- $y_t$ .
- Error in Com624 computation! No p- $y_t$  data! - Com624 computation encountered an error and the program did not produce p- $y_t$ .

If any one of the above warnings is encountered, please check the data. Most of the cases are related to excessive calculated deflection, which exceeds the allowable  $y_t$ . This causes COM624 to terminate the calculations. The problem occurs when the pile is too flexible, soils are too soft, or load is too large.

- Pile too flexible – If the I and E of the pile section are too small, COM624 stops.
- Soils are too soft or loose – If Phi or K is too small for sandy soils and C or  $e50$  is too small for cohesive soils, COM624 stops.
- Load is too large – If P, M, or  $y_t$  is too large, COM624 stops.
- Large surface slope angle or batter angle – If the surface or batter angle is larger than the soil friction angle, COM624 stops.
- Large H – If the distance between pile top and ground surface is too large, COM624 stops.

**HINT: view the COM624 OUTPUT report to get the error message.**

# **CHAPTER 6**

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## ***SETUP OPTIONS***

This chapter details:

- Settings of the program
- User customization and configurations

## 6.1 Setup Screen

The setup screen (Figure 6-1) can be accessed by selecting [**Open Setup**] from the **Setup** pull-down menu.

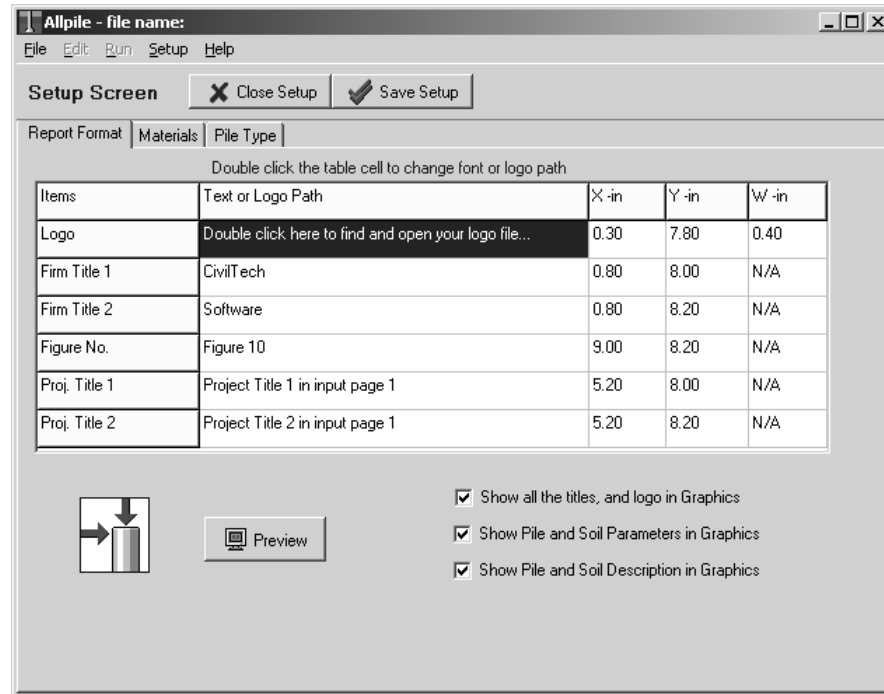


**Figure 6-1. Setup Screen**

The setting of the program is saved in the system. The user can choose to change these settings as they wish. After making the necessary changes to the setting, you could make this your default setting by clicking on [**Save Setup**].

If you make changes on the setup screen but would like to restore your default setting, click on [**Restore Saved Setup**] on the Setup pull-down menu. If you require to restore the manufacturers setting, click on [**Restore Default Setup**] on the Setup pull-down menu. After you are satisfied with the settings, you can return to the program by clicking on [**Close Setup**].

## 6.2 Pull-Down Menu: Setup

|                              |                                                                           |
|------------------------------|---------------------------------------------------------------------------|
| <b>Open Setup</b>            | Open setup screen.                                                        |
| <b>Close Setup</b>           | Close the setup screen without saving the new settings.                   |
| <b>Save Setup</b>            | Save the new settings and not close the screen                            |
| <b>Restore Saved Setup</b>   | Restore the saved settings                                                |
| <b>Restore Default Setup</b> | Restore the manufacturer settings                                         |
| <b>Print Setting</b>         | Summarize setting information in NotePad format which allows you to print |

## 6.3 Speed Bar

The speed bar has two buttons:

|                    |                                                  |
|--------------------|--------------------------------------------------|
| <b>Save Setup</b>  | Save the modified settings                       |
| <b>Close Setup</b> | Close the setup screen and return to the program |

## 6.4 Tabbed Pages

The three tabbed pages are summarized below. Each page is described in detail in this chapter.

|                       |                                      |
|-----------------------|--------------------------------------|
| <b>Report Format</b>  | Customize graphical output (reports) |
| <b>Materials page</b> | Configure pile materials             |
| <b>Pile Type</b>      | Configure pile type and method code  |

### 6.4.1 Report Format Page

You can customize the format of the output report by designating the position of each item. The location of each item are position based on coordinates, where (0,0) is located at the upper left corner of the page. Positive X is in the direction to the right, and positive Y is in the direction vertically downwards. The units of measurements are in inches or centimeters.

The items listed in the rows are as follows:

|                                                  |                                                                                                                                                                                                                                                                        |
|--------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Logo</b>                                      | The logo shown in the report can be a bmp, gif, or jpeg file. Double click the row to specify the file path. The width of the logo can be changed on the right most column (W) in inches or centimeters.                                                               |
| <b>Firm Title 1</b>                              | Your company name is presented here. X and Y define the coordinates. Double click the row to select text font.                                                                                                                                                         |
| <b>Firm Title 2</b>                              | You may enter a company subtitle here. X and Y define the coordinates. Double click the row to select text font.                                                                                                                                                       |
| <b>Figure Number</b>                             | The page or figure number in the report. X and Y define the coordinates. Double click the row to select text font. The page number shown in the table is a dummy. The actual text in the report is from the Lateral Analysis Result or Vertical Analysis Result panel. |
| <b>Project Title 1<br/>&amp; Project Title 2</b> | This row specifies the location and font of the project title. X and Y define the coordinates. The text shown in the table is a dummy. The actual text in the report is from the Pile Type page.                                                                       |

**Options:****Show all titles,  
and logos in  
Graphics**

Turns on and off all the titles and logo in graphical report. It is useful for copying and pasting to other Windows programs.

**Show Pile and  
Soil parameters  
in Graphics**

Turns on and off all pile and soil parameters in Profile graphical report.

**Show Pile and  
Soil Description  
in Graphics**

Turns on and off all pile and soil descriptions in Profile graphical report.

**Preview:**

Clicking on the [Preview] button will allow you to see the template of the report.

## 6.4.2 Materials Page

This page sets the properties for the pile materials. The Materials Page (Figure 6-2) has two tables. The first table is the materials for the outside skin of the pile. The second table is inside materials of the pile.

**Outside Skin Materials:**

|                    | Delta -ratio, degree | Ca -ratio, lb/ft <sup>2</sup> | E -kp/ft <sup>2</sup> | G -lb/ft <sup>3</sup> |
|--------------------|----------------------|-------------------------------|-----------------------|-----------------------|
| Steel (rough)      | 25.0                 | 1.0                           | 29000                 | 487.0                 |
| Steel (smooth)     | 20.0                 | 1.0                           | 29000                 | 487.0                 |
| Concrete (rough)   | 0.8                  | 1.0                           | 3000                  | 150.0                 |
| Concrete (smooth)  | 0.7                  | 1.0                           | 3000                  | 150.0                 |
| Grouted            | 0.0                  | 2000.0                        | 3000                  | 150.0                 |
| Post-Grouted       | 0.0                  | 3000.0                        | 3000                  | 150.0                 |
| Timber             | 0.8                  | 1.0                           | 500                   | 50.0                  |
| Plastic            | 0.7                  | 1.0                           | 600                   | 85.0                  |
| No-Skin Resistance | 0.0                  | 1.0                           | 29000                 | 487.0                 |
| Soil Cohesion      | 1.0                  | 1.0                           | 3000                  | 150.0                 |

**Inside Materials:**

|          | E -kp/ft <sup>2</sup> | G -lb/ft <sup>3</sup> |
|----------|-----------------------|-----------------------|
| =Outside | N/A                   | N/A                   |
| Hollow   | 0                     | 0.0                   |
| Steel    | 29000                 | 487.0                 |
| Concrete | 3000                  | 150.0                 |

**Figure 6-2. Materials Page**

Each material in the table has four properties that can be customized:

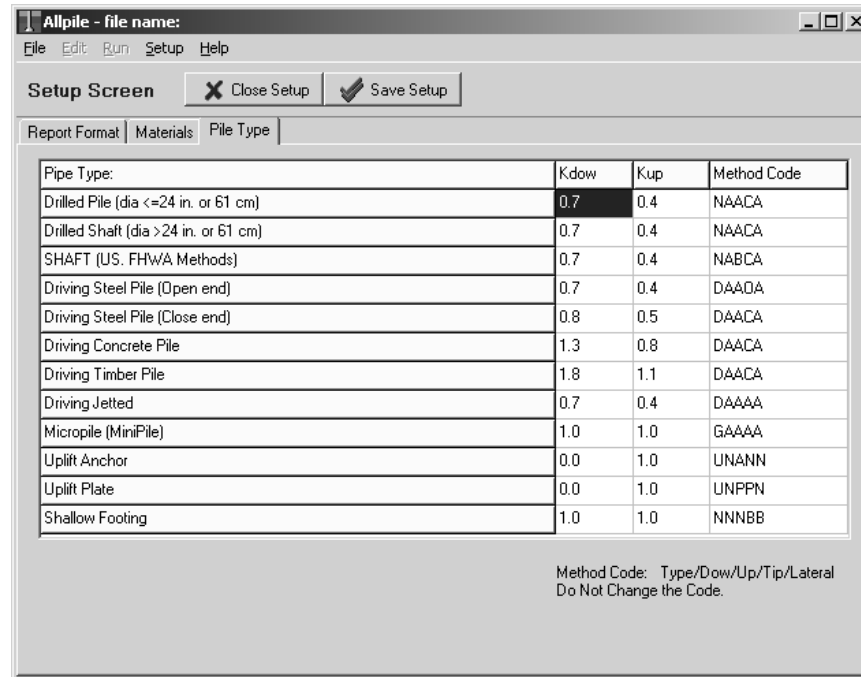
|                                                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|-----------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Skin Friction Angle <math>\delta</math> or Friction <math>K_f</math></b> | <p>Defines the skin friction, <math>\delta</math>, between granular soils and the pile.</p> <ul style="list-style-type: none"> <li>If you input a value within 10 to 50, the program will recognize it as skin friction (<math>\delta</math>)</li> <li>If you input a value ranging from 0.1 to 1, the program multiplies the factor by the soil internal friction, <math>\phi</math> to get the skin friction, <math>\delta</math>:<br/> <math display="block">\delta = K_f \cdot \phi</math> <p>Where, <math>K_f</math> – friction factor (0.1 ~ 1)</p> </li> </ul> <p><b>NOTE: Internal friction, <math>\phi</math>, is the friction between granular soil particles. Skin friction, <math>\delta</math>, is the skin friction between soil and pile. <math>\delta</math> is not the same as <math>\phi</math> -- usually <math>\delta</math> is less than <math>\phi</math>.</b></p> |
| <b>Adhesion <math>C_a</math> or Factor <math>K_c</math></b>                 | <p>Defines the adhesion, <math>C_a</math>, between cohesive soils and the pile.</p> <p>If you input a value ranging from 10 or more, the program recognizes it as adhesion, <math>C_a</math>.</p> <p>If you input a factor (range 0.1 to 1), the program multiplies the factor by the soil cohesion, <math>C</math>, to get the adhesion, <math>C_a</math>:</p> $C_a = K_c \cdot C$ <p>Where, <math>K_c</math> – adhesion factor (0.1 ~ 1)</p> <p><b>NOTE: Cohesion, <math>C</math>, is the shear strength between cohesive soils. Adhesion, <math>C_a</math>, is the shear resistance between soil and pile. <math>C_a</math> is not equal to <math>C</math>. Usually <math>C_a</math> is less than <math>C</math>.</b></p>                                                                                                                                                             |
| <b>E</b>                                                                    | Defines elastic modulus of pile materials.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| <b>G</b>                                                                    | Specifies unit weight of pile materials.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |

The second table is the materials properties of the inside of the pile. For example, a steel pipe pile filled with concrete has outside materials = steel and inside materials = concrete. A concrete pile with steel bars has outside materials = concrete and inside materials = steel. The material properties can be customized:

|          |                                                   |
|----------|---------------------------------------------------|
| <b>E</b> | Defines elastic modulus of inside pile materials. |
| <b>G</b> | Specifies unit weight of inside pile materials.   |

### 6.4.3 Pile Type Page

The Pile Type page is shown in Figure 6-3. The table in this page defines the pile type and method code. The pile types listed in this table is the same list on the Pile Type input page (Figure 4-1).



| Pipe Type:                           | K <sub>dow</sub> | K <sub>up</sub> | Method Code |
|--------------------------------------|------------------|-----------------|-------------|
| Drilled Pile (dia <=24 in. or 61 cm) | 0.7              | 0.4             | NAACA       |
| Drilled Shaft (dia >24 in. or 61 cm) | 0.7              | 0.4             | NAACA       |
| SHAFT (US. FHWA Methods)             | 0.7              | 0.4             | NABCA       |
| Driving Steel Pile (Open end)        | 0.7              | 0.4             | DAADA       |
| Driving Steel Pile (Close end)       | 0.8              | 0.5             | DAACA       |
| Driving Concrete Pile                | 1.3              | 0.8             | DAACA       |
| Driving Timber Pile                  | 1.8              | 1.1             | DAACA       |
| Driving Jetted                       | 0.7              | 0.4             | DAAAA       |
| Micropile (MiniPile)                 | 1.0              | 1.0             | GAAAA       |
| Uplift Anchor                        | 0.0              | 1.0             | UNANN       |
| Uplift Plate                         | 0.0              | 1.0             | UNPPN       |
| Shallow Footing                      | 1.0              | 1.0             | NNNBB       |

Method Code: Type/Dow/Up/Tip/Lateral  
Do Not Change the Code.

Figure 6-3. Pile Type Setup Page

#### **K<sub>down</sub>**

The horizontal to vertical stress ratio for calculations of downward (compression) capacity. You can modify the factor based on your experience. See Chapter 8.

$$K_{down} = \text{Vertical Stress} / \text{Horizontal Stress}$$

Driven pile (displacement pile):  $K_{down} \geq 1$

Drilled pile (no-displacement pile):  $K_{down} < 1$

#### **K<sub>up</sub>**

The horizontal to vertical stress ratio for calculations of uplift capacity. You can modify the factor based on your experience. See Chapter 8.

$$K_{up} = \text{Vertical Stress} / \text{Horizontal Stress}$$

Driven pile (displacement pile):  $K_{up} \geq 1$

Drilled pile (no-displacement pile):  $K_{up} < 1$

#### **Method Code**

This section is for the program's internal use. This should not be changed unless you are familiar with the code. A code including five letters to define the calculation method for each pile type. Each letter is explained below:

- 1<sup>st</sup>**      Pile installation method:
  - D – Driven pile (displacement pile)
  - N – Drilled pile (no-displacement pile)
- 2<sup>nd</sup>**      Downward calculation method:
  - A,B,C ... - reserved for different methods
  - O – No calculation
- 3<sup>rd</sup>**      Uplift calculation method:
  - A,B,C ... reserved for different methods
  - O – No calculation
- 4<sup>th</sup>**      Tip resistance calculation method:
  - A,B,C ... reserved for different methods
  - O – No calculation
- 5<sup>th</sup>**      Lateral calculation method:
  - A – COM624P method
  - O – No calculation

# **CHAPTER 7**

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## **SAMPLES**

This chapter lists:

- Examples that are available within the program

## 7.1 Samples

Samples with different soil conditions and pile types are included in the program. These examples are intended to demonstrate the capabilities of the program and allow users to learn more about the input process and other key functions. The samples include:

1. Auger Cast Concrete Pile
2. Drilled Shaft No Bell
3. Drilled Shaft with Bell
4. FHWA SHAFT Method with Bell
5. Driving Steel Pipe, Close Ended
6. Driving Steel Pipe, Open Ended
7. Driving Steel H Pile, Open Ended
8. Driving Steel Pile in Sloped Ground
9. Driving Steel Pile with Battered Angle
10. Driving Concrete Pile with Battered Angle
11. Driving Concrete Pile with Stinger
12. Driving Timber Pile with Battered Angle
13. Driving Jetted Pile
14. Micropile with Pressure Grout
15. Uplift Anchor based on Soil Strength
16. Uplift Anchor based on Bound Strength
17. Uplift Plate in Shallow Mode
18. Uplift Plate in Deep Mode
19. Shallow Foundation
20. COM624 Sample 1, One Soil
21. COM624 Sample 2, Five Soils
22. COM624 Sample 3, in Butter Angle
23. COM624 Sample 4, P-Y Input
24. COM624 Sample 5, Sloped Ground
25. Group Steel Piles
26. Group Auger Cast Piles
27. Group Pre-cast Concrete Piles
28. Tower Mono-Pile
29. Tower with 3 Piles
30. Tower with 4 Piles

Please open the sample files stored in the program and run them to see the input and output data. The samples are in English units. For Metric (SI) units, open the sample then choose metric on the Pile Type page.